

The Hartford Working Group

Hartford, Illinois



Health and Safety Plan for the Hartford Area Hydrocarbon Plume Site

Prepared by:

ENSR Corporation

and

Clayton Group Services, Inc.

for

The Hartford Working Group

July 2004

ENSR Document No.: 01005-093-300



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July 22, 2004

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**RE: Health and Safety Plan
Hartford Area Hydrocarbon Plume Site
Hartford, Illinois**

Dear Sirs:

The enclosed Health and Safety Plan (HASP) is submitted to the U.S. Environmental Protection Agency (USEPA) in accordance with Section VI Paragraph 57 of the Administrative Order of Consent (AOC) finalized by the USEPA on June 24, 2004 for the Hartford Area Hydrocarbon Plume Site (Site). ENSR Corporation (ENSR) and Clayton Group Services, Inc. (Clayton) have prepared this submittal on behalf of the Hartford Working Group (HWG).

This submittal contains ENSR's and Clayton's HASP for the respective field work being conducted by each firm at the Site. Please give us a call at (630) 836-1700 if you have any questions or comments.

Sincerely,

Ralph Feeney
Program Manager

David A. Schumacher, P.G.
Program Manager

enclosure: *Health and Safety Plan, Hartford Area Hydrocarbon Plume Site, Hartford, Illinois,
July 2004, ENSR Project No. 01005-093-300*

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HEALTH AND SAFETY PLAN

IMPLEMENTATION OF INTERIM MEASURES

HARTFORD AREA HYDROCARBON PLUME SITE

HARTFORD, ILLINOIS

Prepared by: Kathleen Harvey

Date: July 2004

Approved by: _____
ENSR Project Manager

Date: _____

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ATTACHMENT C	Blank Job Hazard Analysis Form
ATTACHMENT D	Health & Safety Plan Pre-Entry and Daily Briefing Attendance Form
ATTACHMENT E	Supervisors' Accident Investigation Report Form

1.0 INTRODUCTION

1.1 HASP Applicability

This site-specific Health and Safety Plan (HASP) has been developed by ENSR Corporation (ENSR). It establishes the health and safety procedures to minimize any potential risk to ENSR and subcontractors hired by ENSR involved with the implementation of the Interim Measures at the Hartford Area Hydrocarbon Plume Site (the Site) located in Hartford, Illinois. These tasks are being performed as part of an overall interim measures designed to mitigate potentially unsafe conditions in buildings and residences due to the presence of petroleum hydrocarbons in soil and groundwater underlying the Village of Hartford, Illinois.

ENSR is performing this work on behalf of the Hartford Working Group (under contract to Atlantic Richfield Company). Representatives of Atlantic Richfield Company, Premcor Refining Group, and Shell Oil Product US have organized to form the Hartford Working Group (HWG). Implementation of the proposed interim measures is a voluntary effort by the HWG in cooperation with the U.S. Environmental Protection Agency (U.S. EPA) and the Illinois Environmental Protection Agency (IEPA), and Illinois Department of Public Health (IDPH).

The provisions of this plan apply to all ENSR personnel and ENSR subcontractor personnel who may potentially be exposed to safety and/or health hazards related to activities described in Section 3.0 of this document. Current subcontractors to ENSR include:

- GRP Mechanical (foundation sealing and ventilation system installation)
- MRK Environmental Exploration (Drilling services)

This HASP only pertains to the tasks listed in Section 3.0. A task specific HASP or addenda to this HASP will be developed at a later date for any other subsequent investigative/remedial activities.

This HASP has been written to comply with the requirements of the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120). All activities covered by this HASP must be conducted in complete compliance with this HASP and with all applicable federal, state, and local health and safety regulations. Additionally, all ENSR personnel and contractors to ENSR are expected to abide by BP's Getting HSE Right Program and to follow BP's Eight Golden Rules of Safety (see Attachment A). Personnel covered by this HASP who cannot or will not comply will be excluded from site activities.

This plan will be distributed to each employee involved with the implementation of the interim measures, as defined in Section 3.0 of this HASP. A copy of this HASP will also be provided to

contractors hired by ENSR to perform work on this program. Each employee must sign a copy of the attached health and safety plan sign-off sheet (see Attachment B).

1.2 Organization/Responsibilities

The implementation of health and safety for this program will be the shared responsibility of the ENSR Project Manager (PM), the ENSR Regional Health and Safety Manager (RHSM), the ENSR Project Site Safety Officer (SSO), other ENSR staff and contractors hired by ENSR. All parties are expected to work in concert with each other to achieve the project goals of no accidents, no harm to people and no damage to the environment.

1.2.1 ENSR Project Manager

The ENSR PM (Ralph Feeney) is the individual who has the primary responsibility for ensuring the overall health and safety of this project. The PM therefore has the primary responsibility for ensuring the implementation of the requirements of this HASP. Some of the PM's specific responsibilities include:

- Providing the RHSM with updated information regarding environmental conditions at the project location and the project scope of work;
- Providing adequate authority and resources to the on-site SSO to allow for the successful implementation of all necessary safety procedures;
- Supporting the decisions made by the SSO and RHSM;
- Maintaining regular communications with the SSO and, if necessary, the RHSM;
- Coordinating resident access issues and resident concerns/complaints with the public relations firm, PM & Associates, hired by the Hartford Working Group to assist them with the implementation of this program;
- Ensuring that the selected contractor(s) has completed and passed ENSR's Contractor Safe Evaluation Process;
- Providing all ENSR subcontractors working at this project location with a copy of BP's Gettin' HSE Right Program and BP's Eight Golden Rules of Safety; and,
- Coordinating the activities of all subcontractors and ensuring that they are aware of the pertinent health and safety requirements for this project.

1.2.2 ENSR Regional Health and Safety Manager (RHSM)

The ENSR RHSM (Kathleen Harvey) is the individual responsible for the preparation, interpretation and modification of this HASP. Modifications to this HASP which may result in less stringent precautions cannot be undertaken by the PM or the SSO without the approval of the RHSM. Specific duties of the RHSM include:

- Writing, approving and amending the HASP for this project;
- Advising the PM and SSO on matters relating to health and safety on this project;
- Recommending appropriate personal protective equipment (PPE) and air monitoring instrumentation to protect personnel from potential site hazards;
- Conducting accident investigations; and,
- Maintaining regular contact with the PM and SSO to evaluate project conditions and new information which might require modifications to the HASP.

1.2.3 ENSR Site Safety Officer (SSO)

The ENSR SSO, appointed by the PM, will be on-site during all the activities covered by this HASP. Due to the many tasks associated with this overall program, a different SSO may be assigned to each major phase of work or distinct set of tasks. As an example, one SSO may be appointed to the drilling operations, one for the laboratory work and air monitoring events and one for the foundation sealing and ventilation system installation.

The SSO is responsible for enforcing the requirements of this HASP (as they apply to the scope of work for which each SSO is responsible) once on-site work begins. The SSO has the authority, and the responsibility, to immediately correct all situations where noncompliance with this HASP is noted and to immediately stop work in cases where an immediate danger is perceived. Some of the SSO specific responsibilities include:

- Assuring that all personnel to whom this HASP applies have attended a pre-entry briefing prior to entering an exclusion zone;
- Assuring all personnel participate in the daily safety meetings;
- Maintaining a high level of health and safety consciousness among employees at the work site;
- Procuring and distributing the PPE needed for this project for ENSR employees;

- Procuring the air monitoring instrumentation required and performing the required air monitoring;
- Procuring the necessary material safety data sheets (MSDSs) for any hazardous substances that ENSR may use during the implementation of the interim measures program;
- Verifying that all PPE and health and safety equipment used by ENSR is in good working order;
- Verifying that the subcontractors have the required PPE and safety equipment for the tasks they are performing;
- Setting up and maintaining the decontamination zone and assuring proper cleanup of all site personnel;
- Notifying the PM of all noncompliance situations and stopping work in the event that an immediate danger situation is perceived;
- Monitoring and controlling the safety performance of all personnel within the established restricted areas to ensure that required safety and health procedures are being followed;
- Conducting accident/incident investigations and preparing accident/incident investigation reports
- Conducting the pre-entry briefing and daily safety meetings as required by Section 10.0 of the HASP; and,
- Initiating emergency response procedures in accordance with Section 11.0 of this HASP.

1.2.4 ENSR Field Personnel and Covered Contractor Personnel

All ENSR field personnel and contractor personnel covered by this HASP are responsible for following the health and safety procedures specified in this HASP and for performing their work in a safe and responsible manner. Some of the specific responsibilities of the field personnel are as follows:

- Reading the HASP in its entirety prior to the start of on-site work;
- Submitting a completed HASP Acceptance Form and documentation of medical surveillance and training, as applicable, to the ENSR PM prior to the start of work;
- Attending the required pre-entry briefing prior to beginning on-site work and subsequent daily safety meetings;

- Bringing forth any questions or concerns regarding the content of the HASP to the PM or the SSO prior to the start of work;
- Reporting all accidents, injuries and illnesses, regardless of their severity, to the ENSR SSO; and,
- Complying with the requirements of this HASP and the requests of the SSO.

1.2.5 Subcontractors to ENSR

In addition to other requirements referenced in this HASP, all contractors covered by this HASP are required to:

- Comply with the requirements of this HASP and the directions of the SSO;
- Ensure, via daily inspections, that their equipment is in good working order;
- Immediately report to ENSR, any accidents, injuries, or near misses;
- Operate their equipment in a safe manner;
- Provide ENSR with copies of MSDSs for all hazardous materials brought on-site;
- Provide all the required PPE and respiratory equipment for their employees;
- Review BP's Getting HSE Right Program and BP's Eight Golden Rules of Safety prior to arriving on site and agree to implement the requirements of these programs; and,
- Appoint an on-site safety coordinator to interface with the ENSR SSO.

1.3 Management of Change/Modification of the HASP

1.3.1 Management of Change

The procedures in this HASP are based on the proposed scope of work and existing information regarding the types and extent of contamination that may be encountered during the implementation of the proposed interim measures. Every effort has been made to address the chemical hazards that may be encountered during the implementation of the tasks associated with the proposed program. Similarly, this document also discusses the physical hazards associated with the proposed scope of work. However, unanticipated site-specific conditions or situations may occur during the implementation

of this project. Also, ENSR and/or the chosen contractor(s) may elect to perform certain tasks in a manner that is different from what was originally intended due to a change in field conditions. As such, this HASP must be considered a *working document* that is subject to change to meet the needs of this dynamic project.

Therefore, ENSR and/or the selected contractor(s) will review the proposed operations prior to beginning each major phase of work to ensure that all chemical and physical hazards have been properly addressed. It is further suggested that GRP Mechanical representatives and ENSR's Field Construction Manager perform this review prior to working in each new residence as the mitigation measures being implemented in each home will differ slightly from previous homes. The use of new techniques will be reviewed. If new hazards are associated with the proposed changes and/or new work techniques, they will be documented on the Job Hazard Analysis (JHA) form. An effective control measure must also be identified for each new hazard. New work and/or new techniques can not begin until the identified control measures are in place.

JHAs will be reviewed by the SSO prior to being implemented. Once approved, the JHAs will be reviewed with all field staff during the daily safety meeting. A blank JHA is presented as Attachment C.

1.3.2 HASP Modifications

Should significant information become available regarding potential on-site hazards, it may be necessary to modify this HASP. All proposed modifications to this HASP must be reviewed and approved by the ENSR RHSM before such modifications are implemented. Any significant modifications must be incorporated into the written document as addenda and the HASP must be reissued. The ENSR PM will ensure that all personnel covered by this HASP receive copies of all issued addenda. Sign-off forms will accompany each addendum and must be signed by all personnel covered by the addendum. Sign-off forms will be submitted to the ENSR PM. The HASP addenda should be distributed during the daily safety meeting so that they can be reviewed and discussed. Attendance forms will be collected during the meeting.

2.0 SITE DESCRIPTION AND HISTORY

2.1 History of Petroleum Refining Operations

The Village of Hartford, Illinois is located along the Mississippi River in southwestern Illinois near St. Louis, Missouri (Figure 2-1). Since the early 1900's, the area surrounding Hartford has been used for petroleum refining operations and the transportation of crude oil and refined petroleum products. These operations have occurred in various locations surrounding Hartford.

2.2 Previous Investigation Results

Various parties have conducted a number of previous investigations to understand the nature and extent of petroleum hydrocarbons in the soil and groundwater underlying Hartford. The results of these investigations have been summarized in various previous reports.

The general conclusions that have been made relative to the occurrence of petroleum vapor complaints by residents include the following:

- Complaints of petroleum odors generally occur when groundwater elevations begin to rise.
- Most complaints have occurred in the spring and early summer months when rainfall is generally highest and groundwater elevations tend to rise.
- Some complaints appear to be associated with heavy rainfall events.

Previous investigations have shown that the Village of Hartford is underlain by approximately 15 to 30 feet of silty-clay soil having relatively low permeability and low infiltration capacity. The silty-clay overlies sand and gravel deposits having relatively high permeability. Free-phase petroleum product is present on the water table at a depth of 30 to 35 feet below ground surface.

Other groundwater zones may be encountered in the shallow silty-clay and within silty-clay layers above the main water table in the sand and gravel. Buried within the silty-clay are petroleum pipelines as well as other buried utilities including, but not limited to, natural gas pipelines and service lines; sanitary and storm sewer lines; water mains and services lines; and lateral piping for a vapor control system installed in the early 1990s.

It appears that petroleum vapors migrate upward from the sand and gravel deposits through secondary porosity features (i.e., fractures and cracks) in the shallow silty-clay soils. Vapor migration and intrusion into homes appears to be enhanced as the water table rises in response to rising water levels in the nearby Mississippi River and recharge through rainfall. Saturation of the shallow silty-clay soils at the ground surface during and following rainfall events and freezing of the ground surface during the winter appears to form a cap that prevents vapors from escaping through areas of open ground surface. This capping effect may force vapors towards basements and building foundation

which are easier pathways for the vapors to migrate through (i.e., the path of least resistance to vapor flow).

2.3 Odor Complaints and Fire Occurrences

Complaints regarding petroleum vapors have been documented in Hartford since the 1960's. The majority of these complaints have occurred in the northern half of Hartford, in the area roughly defined by Hawthorne Avenue to the south, Route 3 to the west, Rand Avenue to the north, and Olive Street to the east. In some cases, fires have been reported.

2.4 Vapor Control System

Clark Oil installed a vapor control system in Hartford in 1992. This system is still in operation today. An evaluation of this system was conducted by Clayton Group Services (Clayton) in the summer of 2003 and the results can be found in their August 14, 2003 report (Clayton, 2003). The vapor control system has removed petroleum vapors from the subsurface since it was installed. Clayton currently conducts system maintenance activities.

2.5 Indoor Air Monitoring Results

The Hartford Working Group understands that the IEPA, U.S. EPA, and/or IDPH have conducted indoor air monitoring at residences in Hartford to assess potential vapor intrusion issues. A data set representing indoor air sampling results from 18 residences was provided to the Hartford Working Group. These samples were collected and analyzed by the IDPH during the summer of 2003. However, specific addresses where these samples were collected could not be provided in accordance with State regulations.

Initial review of the IDPH's indoor air monitoring data indicates that, with the exception of two samples, benzene concentrations at the residences were below the ATSDR benzene guidance of $32 \mu\text{g}/\text{m}^3$ used by the IDPH for comparison.

The IDPH's indoor air monitoring data also indicates the presence of other compounds, in particular propane, ethane, and butane. The source of these compounds is apparently unknown. However, they may be related to natural gas leaks or other potential sources in the homes. No information was provided with the data regarding sampling procedures and methods, or the potential presence of other indoor sources of vapors that may have affected these analytical results.

3.0 SCOPE OF WORK

3.1 Overall Interim Measure Objectives

The Interim Measure objective is to prevent the intrusion of petroleum vapors into buildings and residences in order to mitigate potential hazardous conditions and complaints of petroleum odors. To meet this objective, the Hartford Working Group is proposing to assess individual buildings and residences in Hartford for the presence of petroleum vapor intrusion. For those buildings and residences where it is deemed necessary to mitigate petroleum vapor intrusion, the Hartford Working Group will offer and implement the sealing of building foundations and installation of ventilation fans in buildings within a specified area of the Site (i.e. north of, and including, Hawthorne Street).

3.1.1 Foundation Sealing and Ventilation System Installation

The major tasks associated with the foundation sealing and ventilation system installation program being implemented in the mitigation measures offer area includes:

- Performing building walk-throughs including the collection of indoor air quality data and preparing a construction take-off for each building;
- Implementing and overseeing the foundation sealing and fan installation activities and,
- Monitoring the effectiveness of the mitigation measures by collecting indoor air quality data.

3.2 Building Walk-Throughs

Letters offering to complete the sealing and ventilation system installation work have been sent to building owners in the mitigation measures offer area. Acceptance of the offer will initiate a walk-through of the building. Three representatives of the HWG will conduct the walk-throughs. The team consists of two ENSR employees, including a Needs Assessor and a Field Construction Manager, and a contractor representative that would be conducting the sealing and ventilation system installation. Representatives of the U.S. EPA and/or IEPA will also be present.

The Needs Assessor will conduct a needs assessment interview with the building resident/owner and document the building construction. The Assessor will monitor the indoor air quality of the building using direct-reading air monitoring instrumentation and collecting indoor air samples using SUMMA® canisters for laboratory analyses. The Assessor will prepare the final Needs Assessment forms and building construction diagrams.

The Field Construction Manager will perform a detailed inspection of the building foundation and identify openings where vapors could potentially enter the building. If necessary, the contractor will be instructed to immediately seal vapor entry points. The Manager will review the final building construction diagrams and work with project field engineers to finalize the construction take-off. The Field Construction Manager who conducted the initial walk-through will be present during the implementation of the mitigation measures to oversee the activities of the contractor.

3.2.1 Foundation Sealing

Foundation sealing procedures may include sealing cracks in concrete floors with concrete and finishing with an epoxy sealant, with polyurethane caulk or with epoxy. The sealant used will depend on the size of the cracks. Concrete may be placed in basements that have earthen, unfinished floors. It may be necessary to remove soil to prepare the area for the pouring of concrete. Small amounts of soil will be removed by hand-shoveling into pails and disposing of the material in a larger drum located outside of the home. A vacuum truck may be required if a larger amount of soil needs to be removed.

Concrete block walls will also be inspected for cracks and filled with epoxy and/or a water-based latex vapor/waterproof sealant. Mortar joints covering field stone and brick walls will be inspected. Walls requiring repair to seal large cracks and joints in the mortar will be sealed with epoxy and/or re-tuck pointed. A polyethylene vapor barrier may also be installed over the stone, brick or wood wall.

Basements will be inspected for the presence of floor drains, conduits and open pipes. Floor drains will be plugged and electrical conduits and open pipes penetrating the walls and/or floors of the basement will be sealed with polyethylene caulk.

3.2.2 Ventilation Systems

3.2.2.1 Ventilation Fans

Ventilation fans consisting of direct-drive exhaust fans with movable-blade louvers will be mounted in residences with basement windows. Each ventilation fan will be installed by securing it to a wooden frame that is constructed to fit within the window opening. In basements with no windows or exterior openings, a direct-drive floor -or-wall mounted blower may be used. The blower will consist of a high volume fume exhauster having an enclosed impeller wheel. Each blower unit will be installed by securing the blower base to the floor or basement wall to prevent movement during operation and connecting an air duct from the blower discharge through the basement wall.

The operation of ventilation systems may have an effect on the air temperatures and humidity within the basement areas. Water pipes will be fitted with elastomer foam rubber pipe insulation.

to prevent condensation from forming in the warmer months and to prevent pipes from freezing during colder months.

Each basement equipped with a ventilation fan or blower will also have a fresh air intake installed. The fresh air intake will consist of an opening that allows outside ambient air to enter the basement during fan or blower operation. At locations where windows or exterior openings are present, a movable-blade wall louver will be installed within the opening. The fresh air intakes will be placed in a separate window and as far from the fan as possible. At locations where windows or exterior openings are not present, a basement wall penetration will be made to install an air inlet duct.

3.2.2.2 Sub-Slab Ventilation Systems

A sub-slab ventilation system will be installed at residences where it is deemed necessary and/or where a vent fan is not adequately working. The system will consist of PVC piping which penetrates the floor of the basement into a gravel void below the slab. The piping will then run through an opening in the basement wall to a moisture separator with heat tape and a regenerative blower.

3.2.3 Effectiveness Monitoring

Indoor air samples will be collected using SUMMA® canisters during the walk-through and analyzed by ENSR in a fixed, on-site laboratory. Upon completion of mitigation measures, indoor air samples will be collected again to determine the effectiveness of the measures. In addition, upon completion of ventilation fan installation, tests will be conducted to insure that the fans are not drawing gases from the water heater and/or furnace. Specifically, a carbon monoxide (CO) meter will be used to determine this while the ventilation fan is on and off. A direct comparison of CO readings will determine whether a negative pressure is affecting the migration of vapors and CO into the basement during ventilator operation.

3.3 Contingency Plan Response

The HWG developed a Contingency Plan to summarize how the HWG will support the Hartford Fire Department's efforts to address petroleum vapor complaints made by the residents of Hartford. As part of this plan, it may be necessary for ENSR to conduct a needs assessment at the home and/or collect indoor air samples from the home.

3.4 Vapor Migration Pathway Assessment

A Vapor Migration Pathway Assessment will be conducted to evaluate and identify migratory routes into residences and buildings in Hartford. The overall objective of the assessment is to evaluate vapor migration through native soils and fill material, and through utility corridors/line

An element of the assessment will involve soil gas sampling within native soils and within utility trenches as well as "companion" indoor air sampling.

3.4.1 Soil Vapor Sampling Port Installation/ Soil Gas Sampling

The soil located adjacent to the homes and buildings will be assessed. Soil gas samples will be collected to assist in determining if the native fill and/or backfill (if present) surrounding the foundation of the home/building provides a pathway for vapor intrusion. Two to four sampling ports will be installed outside each building being assessed. An auger (manual or electric) Geoprobe™ with an auger adapter or similar device will be used to advance a borehole to install the ports. In addition, two to four soil gas sampling ports will be installed within the utility corridors identified at each location. A hand auger will be used to advance these boreholes.

Soil borings will also be advanced to evaluate geologic features, such as the possible presence of fractures and sand lenses and to install nested soil gas sampling ports. Soil samples will be continuously collected at two-foot intervals from each boring for field screening using a PID and FID.

Soil gas samples will be collected from the soil gas sampling ports twice over a 24-hour period, in conjunction with indoor air monitoring (see below). Samples will be collected utilizing Tedlar bags or SUMMA® canisters.

3.4.2 Indoor Air Sampling

Ambient indoor air samples will be collected in conjunction with soil gas samples from each building. These samples will be collected using SUMMA® canisters over a 24-hour time period.

3.5 Sanitary Sewer Monitoring & Venting

ENSR will perform routine monitoring of selected sanitary sewer systems located beneath the streets of the Village of Hartford for the presence of explosive atmospheres. The sampling is done via manholes associated with the sewer systems. Sewers will be vented via these manholes should atmospheres within the systems exceed 10% of the lower explosive limit (LEL). A pneumatic fan will be used to exhaust the vapors out of the space. ENSR will be monitoring the air exhausted from the manholes during the response measure.

4.0 CHEMICAL HAZARDS

The field team should expect that soils, soil vapors, and groundwater beneath the residential basement floors and exterior subsurface soils are potentially impacted with petroleum hydrocarbons. Similarly, petroleum vapors may have intruded into the basement areas of the homes where needs assessments and/or contingency plan responses are conducted and mitigation systems are being installed.

4.1 Indoor Air Sampling Conducted by Illinois Department of Public Health

On June 5, 2003, the Illinois Department of Public Health (IDPH) collected indoor air samples from 18 homes in Hartford (IDPH, Unpublished Data, 2003). Petroleum constituents were detected in the air samples collected. The compounds detected in the highest concentrations included straight and branched chained aliphatic hydrocarbons (i.e. alkanes, alkenes and alkynes) such as ethane, propane, isobutane, butane, isopentane, pentane and hexane. Aromatic hydrocarbons, including benzene, toluene, ethylbenzene and xylenes as well as trimethylbenzenes, were also detected in the indoor air samples. The concentrations of petroleum hydrocarbons were reported as $\mu\text{g}/\text{m}^3$ or parts per billion (ppb).

4.2 Gasoline and Gasoline-Related Constituents

4.2.1 Gasoline

Gasoline is a clear, volatile liquid with a characteristic odor. It is a complex mixture of aliphatic and aromatic hydrocarbons ranging from C3 to C11 compounds. Typical modern gasoline composition is 80% alkanes, 14% aromatics and 6% alkenes. The mean benzene content is found to be approximately 1%. Gasoline acts as an anesthetic. Acute symptoms of overexposure include irritation of the mucous membranes of the upper respiratory tract, nose and mouth, drowsiness, headache, fatigue and drunken-like behaviors. OSHA has not developed a permissible exposure limit (PEL) for gasoline. The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended a threshold limit value (TLV) of 300 ppm as an 8-hour time weighted average (TWA). However, NIOSH has recommended that exposures to gasoline be kept to the lowest feasible concentration due to the fact that gasoline is a potential occupational carcinogen.

4.2.2 Aliphatic Hydrocarbons

Many of the straight chain aliphatic hydrocarbons are classified as simple asphyxiants that are capable of displacing available oxygen. OSHA has established permissible exposure limits (PELs) for some of these chemicals; however, these PELs are much higher than those established for the more toxic aromatic hydrocarbons. Of greater concern is the extreme flammability of the aliphatic hydrocarbon compounds.

4.2.3 Benzene, Toluene, Ethylbenzene and Xylene

Exposure to benzene, toluene, ethylbenzene and xylenes (BTEX) vapors above their respective OSHA PELs may produce irritation of the mucous membranes of the upper respiratory tract, nose and mouth. Overexposure may also result in the depression of the central nervous system. Symptoms of such exposure include drowsiness, headache, fatigue and drunken-like behaviors. Prolonged overexposure to benzene vapors has detrimental effects on the blood-forming system ranging from anemia to leukemia. The PEL for benzene is 1 ppm as an 8 hour TWA. The ACGIH recommends a TLV of 0.5 ppm. The OSHA PEL for ethylbenzene is 100 ppm. The PEL for toluene is 200 ppm. However, the ACGIH recommends a TLV of 50 ppm for toluene. Xylene is a flammable, colorless liquid with an OSHA PEL of 100 ppm as an 8-hour TWA. Inhalation of xylene vapors above the PEL may result in motor activity changes, irritability and drunken-like behaviors. Xylene vapors are also irritating to the eye.

Hazardous Properties of Potential Chemical Contaminants

Chemical Name	PEL ¹	TLV ²	VP ³	VD ⁴	SG ⁵	SOL ⁶	FP ⁷	LEL ⁸	UEL ⁹
Gasoline	NE	300	>400	3	0.8	Neg.	<-40	1.4	7.6
Benzene	1	0.5	75	2.8	0.88	0.07	12	1.2	7.8
Toluene	200	50	21	3.1	0.87	0.07	40	1.1	7.1
Ethylbenzene	100	100	7	3.7	0.87	0.01	55	0.8	6.7
Xylene	100	100	7	3.7	0.88	0.02	90	0.9	6.7
Ethane	NE	NE	3.1 atm	1.04			-275	3.0	12.5
Butane	NE	800	760	2.04			-140	1.6	8.4
Isobutane	NE	NE	3.1 atm	2.01			-182	1.6	8.4
Pentane	NE	600	420	2.48			-57	1.5	7.8
Isopentane	NE	NE	595	2.48			-51	1.4	7.6
n-Hexane	500	50	120	2.97			-7	1.1	7.5
Methane	SA	SA	NA	NA	0.967	1.49	-306	5	15
1 Permissible Exposure Limit in ppm 2 Threshold Limit Value in ppm 3 Vapor Pressure in mm Hg 4 Vapor Density (air = 1) 5 Specific Gravity (water = 1) 6 Solubility in Water in % 7 Flash Point in °F 8 Lower Explosive Limit in % by volume 9 Upper Explosive Limit in % by volume NE = Not Established SA = Simple Asphyxiant									

4.3 Other Potential Chemical Hazards

4.3.1 Asbestos Containing Materials

Due to the age of the homes, it is possible that piping, boilers or other thermal system equipment may be wrapped in insulation, which may contain asbestos. Asbestos is a naturally occurring mineral fiber (magnesium silicate). Airborne asbestos fibers can be dangerous, even in concentrations, which may not be visible. A scarring of the lungs called asbestosis is caused by heavy exposure to asbestos. Cancer of the lung may also be caused by asbestos exposure. A rare cancer of the lining of the chest cavity called mesothelioma can occur even from low-level exposures. Although the primary route of exposure to asbestos is by inhalation, it can also be inadvertently ingested as a result of poor hygiene practices. The OSHA PEL for asbestos is 0.1 fibers per cubic centimeter of air (f/cc) as an 8-hour TWA.

4.3.2 Mold

Mold may have accumulated on the walls of some of the homes. The presence of the mold may prevent ENSR from performing a complete inspection of the foundation. To complete the inspection, mold may have to be removed from limited areas of the home. Mold removal will be accomplished by applying a dilute bleach solution with an airless sprayer to the impacted area, wiping the mold off the surface, painting the cleaned area with Kilz® and sealing identified cracks.

4.3.3 Exhaust Gases during Interior Work

Much of the proposed work is taking place inside residential homes or other public/private buildings. To avoid the build-up of exhaust gases inside these locations, hand augers and electrically-powered drilling equipment will be used to advance any boreholes through the basement floors. The use of diesel or gasoline powered equipment within the basements is to be avoided.

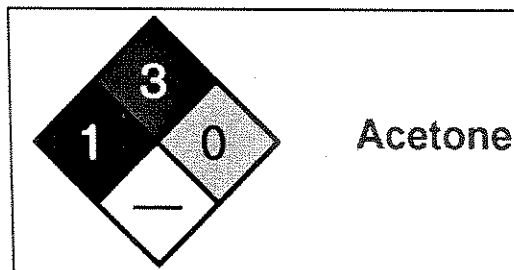
4.3.4 Other Chemicals Used by ENSR or Contractors

ENSR and/or their selected contractors will be using a variety of materials that may contain hazardous substances to facilitate the sealing of foundation cracks or implement other required mitigation measures. Additionally, ENSR will be storing decontamination solutions and compressed gases within the established office storage areas and/or the fixed laboratory. These materials include, but may not be limited to, the following:

- PVC primer and cement to connect piping
- Gasoline to fuel generators

- Epoxy sealants and polyurethane caulking to seal cracks
- Dilute bleach solutions used to remove mold from surfaces
- Decontamination solutions during drilling activities
- Calibration gases for operating the on site laboratory as well as field air monitoring instrumentation

A material safety data sheet (MSDS) must be available for each hazardous substance that ENSR or subcontractor uses during this program. In addition, all containers of hazardous materials must be labeled in accordance with OSHA's Hazard Communication Standard. Either the original manufacturer's label or an NFPA 704M label specific for the material (as shown at the right) is considered to be an acceptable label.



4.4 Chemical Exposure Potential and Control

4.4.1 Chemical Exposure Potential

The primary routes of potential exposure to the field team include direct dermal contact with impacted soil or groundwater during intrusive activities including hand augering, soil boring and vent well, soil gas and monitoring probe installation. Dermal contact with equipment that has come in contact with impacted soil is another potential route of exposure. The inhalation of petroleum vapors may also occur during the proposed intrusive activities. This potential exposure may be increased when performing work indoors while vapors are more likely to dissipate when working exterior to the homes.

Additionally, ENSR employees performing the needs assessment survey, indoor air sampling and/or a contingency plan response may be exposed to vapors that are migrating into the basement areas of the homes and/or other buildings. The likelihood of this type of exposure occurring will increase if the assessments are performed during or after heavy rain events or in the spring and summer when odor complaints have typically been reported.

4.3.2 Chemical Exposure Controls

The potential chemical hazards associated with implementing the proposed interim measures can be controlled in several ways, including:

- As a precaution, ENSR will be conducting air monitoring for total petroleum hydrocarbons and volatile organic compounds during the proposed activities listed in Section 3 of the

HASP. If exposures exceed the action levels as defined in Section 6.1, engineering controls, as discussed in Section 7.2, will be implemented.

- If engineering controls can not be implemented (i.e. basements have no windows) or are unsuccessful in removing vapors from interior spaces, respiratory protection may be necessary. It is not expected that the action level for donning respirators will be exceeded when intrusive work is being performed exterior to the residences or other buildings. However, if the action level is exceeded, respiratory protection will be donned as the use of engineering controls in an outdoor environment is limited.
- To avoid direct dermal contact with impacted soils, protective clothing, as described in Section 7.1, will be required.
- When using dilute bleach solutions to remove mold, protective clothing and respiratory protection, as described in Sections 7.1 and 7.2, will be donned.
- Electrically-powered equipment is being used when advancing boreholes through basement floors to avoid the hazards associated with the build-up of exhaust gases from internal combustion engines.
- Asbestos containing materials (ACM), if present in the basements, will not be disturbed. If the proposed scope of work can not be implemented without damaging suspect ACM, work will be suspended until the proper precautions can be put in place to ensure employees working in the basement will not be exposed to asbestos fibers.
- Although highly unlikely, exposure to all of the contaminants of concern may occur via ingestion (hand-to-mouth transfer). The decontamination procedures described in Section 9.0 address personal hygiene issues that will limit the potential for contaminant ingestion.

5.0 PHYSICAL HAZARDS AND CONTROLS

5.1 Working in and Around Private Residences

Much of the proposed work will take place in and around occupied homes. These assessments will be coordinated with the residents through the Hartford Working Groups public affairs firm, PM & Associates. As the potential hazards associated with working inside a private residence are unique, ENSR has created a separate summary of safety issues and control measures that will be implemented by the needs assessment/walk-through teams. This summary is presented in the table below.

UNIQUE ISSUES DURING WALK-THROUGHS

Issue	Suggested Response
Greeted and immediately threatened either physically or verbally by homeowner	Leave the premises
Unsecured, large dogs or other animals, that are not under the control of the owner	Request that the animal be either removed from the immediate work area or ask that the animal be secured until the visit is completed.
Inadequate Illumination in Survey Areas	Basements may not be equipped with electrical outlets or may not have electrical outlets that meet current codes. ENSR staff will bring portable, battery-operated lighting to each survey location.
Animal and/or dust allergies	Employees who experience adverse allergic reactions should leave the home
Unsanitary conditions (i.e. animal excrement, foul odors not associated with petroleum, presence of rodents)	ENSR employees will not work in homes where unsanitary conditions prevail
Flooded basements	Surveys will not be conducted in flooded areas of the home
Excessive mold due to flooding	Employees who experience adverse reactions to mold should leave the home
Presence of asbestos-containing materials	If proposed scope of work can not be implemented without impacting suspect ACM, work will be suspended until adequate controls can be implemented.
Unexpected emergency arises	ENSR staff will contact local emergency responders using portable communications equipment

5.2 Working in Active Roadways

ENSR will perform routine monitoring of selected sanitary sewer systems located beneath the streets of the Village of Hartford for the presence of explosive atmospheres. The sampling is done via manholes associated with the sewer systems. Sewers will be vented via these manholes should atmospheres within the systems exceed 10% of the lower explosive limit. A pneumatic fan will be used to exhaust the vapors out of the space. ENSR will be monitoring the air exhausted from the manholes during the response measure.

As ENSR and their contractor will be working in active roadways, it will be necessary to implement the following traffic control measures:

- Notify the Hartford Public Works Department of your work location, dates of work and the anticipated work times. Suggest the possibility of a detour around the work area if the work that needs to be performed is expected to be prolonged or will significantly impact traffic.
- Wear an ANSI-approved Class II orange safety vest. These vests will be equipped with reflective tape.
- Set up traffic cones or traffic barricades at least 50 feet in front of the work area. "Men at Work" signs should also be placed in a conspicuous area to warn motorists of your presence in the roadway.
- If the proposed monitoring diverts the flow of traffic out of its normal pattern, ENSR will contact the Hartford police to determine if a police detail is required.

It is possible that ENSR may be performing work in other high traffic areas. This may occur during the implementation of the vapor migration pathway assessments. If so, the precautions above will be implemented in those work areas as well.

5.3 Utility Hazards

5.3.1 Underground Utilities

Illinois law requires that, at least 48 hours prior to initiation of any subsurface work, a utility clearance be performed at the site. The driller (MRK Environmental Exploration) will contact Julie Inc. (815-741-5000) and the Village of Hartford water and sewer companies to request a mark-out of underground utilities in the proposed sampling areas. ENSR will need to contact Julie Inc. when they are performing hand augering work. Work will not begin until the required utility clearances have been performed.

Public utility clearance organizations typically do not mark-out underground utility lines that are located on private property. As such, the contractor must exercise due diligence and try to identify the location of any private utilities on the properties being investigated. The contractor can fulfill this requirement in several ways, including:

- obtaining as-built drawings for the areas being investigated from the property owner;
- visually reviewing each proposed drilling location with the property owner or knowledgeable site representative;
- performing a geophysical survey to locate utilities or hiring a private line locating firm to determine the location of utility lines that are present at the property;
- identifying a no-drill zone; or,
- hand-digging in the proposed drilling locations if insufficient data is available to accurately determine the location of the utility lines.

5.3.2 Vapor Migration Pathway Assessments within the Tolerance Zone

Due to the purpose of the vapor migration pathway assessments, it may be necessary to advance soil borings within utility corridors. In accordance with the Illinois Underground Utilities Damage Prevention Act (the Act), whenever ENSR is advancing soil borings within the "tolerance zone" the borings **MUST BE ADVANCED USING HAND DIGGING**. The tolerance zone is defined in the Act as 18 inches on either side of the center line of a marked utility.

5.3.3 Overhead Utilities

Be particularly aware of overhead power lines in the work area. Any vehicle or mechanic equipment capable of having parts of its structure elevated (drill rig, crane etc.) near energized

overhead lines shall be operated so that a clearance of at least 10 feet is maintained. If the voltage is higher than 50kV, the clearance shall be increased 4 inches for every 10kV over that voltage.

5.4 Drilling Hazards

5.4.1 Concrete Coring

It will be necessary to core through existing basement floors to install soil gas monitoring points and/or sub-slab ventilation system equipment. An increased eye hazard exists during the coring of basement concrete. Employees must wear safety glasses with attached sideshields to protect them from flying debris. Employees may also choose to wear a faceshield over their glasses if impact from the debris is excessive.

5.4.2 Geoprobe™

Use of the Geoprobe™ System to install boreholes will require all personnel in the vicinity of the operating unit to wear steel-toed boots, hardhats, hearing protection and safety eyewear. Personnel shall not remain in the vicinity of operating equipment unless it is required for their work responsibilities. Additionally, the following safety requirements must be adhered to:

- A remote vehicle ignition is located on the control panel of the Geoprobe™ unit. This allows the operator to start and stop the vehicle engine from the rear. This device must be tested prior to job initiation and periodically thereafter. All employees should be aware of how to access and operate the rear ignition.
- The driller must never leave the controls while the probe is being driven.
- Drillers, helpers and geologists must secure all loose clothing when in the vicinity of drilling operations.
- The Geoprobe™ vehicle shall not be moved any distance with the probe in the extended position. Check for clearance at roof or the vehicle before folding the Geoprobe™ out of the carrier vehicle.
- Be sure the parking brake is set before probing.
- Never allow the derrick foot to be lifted more than 6" off of the ground surface.
- Deactivate hydraulics when adding or removing probe rods, anvils or any tool in the hammer.

- Verify that all threaded parts are completely threaded together before probing.

5.4.3 Auger Drilling

It may be necessary to use an auger rig to advance boreholes. This will require all personnel in the vicinity of the operating rig to wear steel-toed boots, hardhats, hearing protection and safety eyewear. Personnel shall not remain in the vicinity of operating equipment unless it is required for their work responsibilities. Additionally, the following safety requirements must be adhered to:

- All drill rigs and other machinery with exposed moving parts must be equipped with an operational emergency stop device. Drillers and geologists must be aware of the location of this device. This device must be tested prior to job initiation and periodically thereafter. The driller and helper shall not simultaneously handle augers unless there is a standby person to activate the emergency stop.
- The driller must never leave the controls while the tools are rotating unless all personnel are kept clear of rotating equipment.
- A long-handled shovel or equivalent must be used to clear drill cuttings away from the hole and from rotating tools. Hands and/or feet are not to be used for this purpose.
- A remote sampling device must be used to sample drill cuttings if the tools are rotating or if the tools are readily capable of rotating. Samplers must not reach into or near the rotating equipment. If personnel must work near any tools that could rotate, the driller must shut down the rig prior to initiating such work.
- Drillers, helpers and geologists must secure all loose clothing when in the vicinity of drilling operations.
- Only equipment approved by the manufacturer may be used in conjunction with sit equipment and specifically to attach sections of drilling tools together. Pins that protrude excessively from augers shall not be allowed.
- No person shall climb the drill mast while tools are rotating.
- No person shall climb the drill mast without the use of ANSI-approved fall protection (approved belts, lanyards and a fall protection slide rail) or portable ladder which meets the requirements of OSHA standards.

5.5 Noise

Use of drilling equipment, air compressors and other construction-related equipment and tools may expose the field team to noise levels that exceed the OSHA PEL of 90 dBA for an 8-hour day. Exposure to noise can result in the following:

- Temporary hearing losses where normal hearing returns after a rest period;
- Interference with speech communication and the perception of auditory signals;
- Interference with the performance of complicated tasks; and,
- Permanent hearing loss due to repeated exposure resulting in nerve destruction in the hearing organ.

During drilling or when working near construction equipment or operating certain power tools, it may be necessary to wear hearing protection. Since personal noise monitoring will not be conducted during the proposed activities, employees must follow this general rule of thumb: If the noise levels are so loud that you must shout at someone who is 5 feet away from you, you need to be wearing hearing protection. ENSR employees can wear either disposable earplugs or earmuffs but all hearing protection must have a minimum noise reduction rating (NRR) of 27 db.

5.6 Cuts and Lacerations

There is the potential for employees to cut themselves on the sharp edges of PVC piping unfinished or jagged edges of metal or during the use of hand tools, as well as knives, handsaws and blades that may be used to cut materials that are needed to install the proposed ventilation systems or to perform other site tasks. To prevent the potential for cuts and lacerations, employees will wear either leather work gloves or Kevlar™ gloves. When using knives or blades for these activities, as well as others that involve the cutting of tubing and/or small diameter piping, follow the safety precautions listed below:

- Keep your free hand out of the way
- Secure your work if cutting through thick material
- Use only sharp blades; dull blades require more force which results in less knife control
- Pull the knife toward you; pulling motions are easier to manage
- Don't put your knife in your pocket
- Use a self-retracting blade
- Wear leather or Kevlar™ gloves when using knives or blades.

5.7 Use of Hand and Power Tools

A variety of hand and power tools may be used during the proposed interim measures. The use of each can pose serious safety hazards to the user.

5.7.1 Hand Tools

The greatest hazards posed by hand tools result from misuse and improper maintenance.

- When using hand tools be sure you have selected the right tool for the job. If a chisel is used as a screwdriver, the tip of the chisel may break or fly off, hitting the user or others.
- Inspect tools for damage such as mushroomed chisel heads or broken hammer handles. If jaws of a wrench are sprung, the wrench may slip. If a wooden handle is loose, splintered or cracked, the head of the tool may fly off.
- Do not use damaged tools.
- Be sure you know how to use the tool you are working with.

5.7.2 Power Tools

To prevent hazards associated with the use of power tools, workers should observe the following general precautions:

- Never carry a tool by the cord or hose.
- Never yank the cord or the hose to disconnect it from the receptacle.
- Keep cords away from heat, oil and sharp edges.
- Disconnect tools when not using them, before servicing or cleaning them and when changing accessories such as blades, bits and cutters.
- Secure work with clamps or vise, freeing up both hands to operate the tool.
- Avoid accidental starting. Do not hold fingers on the switch button when carrying a plugged-in tool.
- Keep tools sharp and clean for best performance.
- Wear appropriate clothing. Loose clothing or jewelry can become caught in moving parts.
- Keep all guards in place.

5.7.3 Electric Tools

A variety of power tools will also be used during the installation of the systems. When using portable tools that are electrically powered, follow the safety precautions listed below:

- Check to see that electrical outlets used to supply power during field operations is of the three wire grounding type.

- Extension cords used for field operations should be of the three wire grounding type and designed for hard or extra-hard usage. This type of cord uses insulated wires within an inner insulated sleeve and will be marked S, ST, STO, SJ, SJO or SJTO.
- NEVER remove the ground plug blade to accommodate ungrounded outlets.
- Do not use extension cords as a substitute for fixed or permanent wiring. Do not run extension cords through openings in walls, ceilings or floors.
- Protect the cord from becoming damaged if the cord is run through doorways, windows or across pinch points.
- Examine extension and equipment cords and plugs prior to each use. Damaged cords with frayed insulation or exposed wiring and damaged plugs with missing ground blades **MUST BE REMOVED** from service immediately.
- When working in flammable atmospheres, be sure that the electrical equipment being used is approved for use in Class I, Division I atmospheres.
- Do not touch a victim who is still in contact with current. Separate the victim from the source using a dry, nonmetallic item such as a broomstick or cardboard box. Be sure your hands are dry and you are standing on a dry surface. Turn off the main electrical power switch and then begin rescue efforts.

5.8 Ladder Safety

It is anticipated that employees may be using a portable ladders during this program. The following precautions must be followed when using portable ladders:

- All portable ladders used shall be heavy duty, non-conductive, Type I ladders.
- Make certain that the ladder feet are placed on firm and level surfaces.
- Don't place a ladder on boxes, blocks, barrels or other objects which are moveable to attempt to gain access to a higher location.
- The user should always face the ladder when ascending and descending and both hands should always be free for climbing.
- Use a tool belt or haul equipment up by rope so that hands are free for climbing.

- When climbing ladders, wear shoes equipped with a heel and with slip-resistant soles. Make sure the soles of shoes are free of mud, oil or other slippery materials.
- Only one person is allowed to climb a portable ladder at a time.
- When working off a ladder, keep your body centered on the steps. As a rule of thumb, never let your belt buckle pass beyond either ladder rail.
- Since they will conduct electricity, aluminum ladders should not be used in locations where they may make an electrical contact with an energized circuit. Use a wooden or fiberglass ladder in these circumstances.
- Never climb ladders in severe weather conditions involving high winds or icing.
- Place an extension or straight ladder at such an angle that the base is one-fourth of the working length of the ladder out from the supporting structure.
- The user should stand no higher than four rungs from the top of a straight or extension ladder.
- For access to a roof, the ladder should be long enough so that when positioned at the proper angle, it extends at least 3 feet above the point of support at eave, gutter or roofline.
- All straight or extension ladders must be equipped with non-skid feet and must either be tied off to a support at the top or held by another worker while being climbed.

Because portable ladders are typically unsecured, the practice of attaching a personal lifeline system when climbing a ladder is generally not appropriate. However, when work at heights is performed off of a portable ladder, a personal lifeline system should be used if there is a convenient and appropriate anchorage point, other than the ladder itself, to attach to.

5.9 Back Safety

It is anticipated that some of the resident's belongings may have to be packed and moved to successfully complete the walk-through, foundation sealing and ventilation system installation. Using the proper techniques to lift and move heavy pieces of equipment during the packing and relocation process is important to reduce the potential for back injury. The following precaution should be implemented when lifting or moving heavy objects:

- Use mechanical devices to move objects that are too heavy to be moved manually (i.e. drum dolly or cart).
- If mechanical devices are not available, ask another person to assist you.

- Bend at the knees, not the waist. Let your legs do the lifting.
- Do not twist while lifting
- Bring the load as close to you as possible before lifting
- Be sure the path you are taking while carrying a heavy object is free of obstructions and slip, trip and fall hazards.

5.10 Compressed Gas Handling and Storage

ENSR has established an on-site laboratory equipped with a gas chromatograph and mass spectrometer and will therefore be handling and storing compressed gas cylinders. The improper handling or storage of compressed gases can cause:

- An uncontrolled release of potentially toxic and/or flammable gases;
- Displacement of oxygen by the cylinder contents if cylinder is leaking in an inadequately ventilated area;
- Vessel rupture causing the cylinder to become a projectile; and,
- Injury due to inappropriate lifting and moving of cylinders.

To ensure that compressed gas cylinders are properly handled and stored within the on-site laboratory trailer, ENSR will implement the following procedures.

- Visually inspect all cylinders upon delivery and verify that they are properly labeled.
- Do not store cylinders in direct sunlight (increase in temperature will increase pressure) or near radiators or other sources of heat
- Use a cylinder dolly to move the cylinders. Do not attempt to pick the cylinder up.
- Do not allow cylinders to be dropped, struck or permitted to strike each other violently.
- Keep cylinder valves closed at all times (except when in use).
- Open valves slowly and away from people.
- Close the valve and relieve the pressure before removing the regulator.
- Always keep the valve cap over the valve assembly when not in use (break in valve will cause cylinder to become a projectile).
- Cylinders must be stored in the upright position and must be secured in a suitable rack or secured to a fixed structure by a chain or rope so they will not be knocked over.
- Cylinders should be separated from readily ignitable materials by at least 20 feet.
- Segregate empty cylinders from full cylinders.
- Oxygen cylinders must be stored at least 10 feet away from cylinders containing flammable gases

Hydrogen is used as the fuel for the flame ionization detector being used on site. ENSR is storing hydrogen on site in the laboratory trailer. Hydrogen can be ignited by an almost imperceptible spark or by static electricity discharge. Inside buildings, cylinders of hydrogen must be separated from oxygen cylinders by a minimum distance of 20 feet. Conspicuous signs must be posted in hydrogen storage areas forbidding smoking and open flames.

5.11 Slip, Trip and Fall Hazards

Maintaining a work environment that is free from accumulated debris is the key to preventing slip, trip and fall hazards at construction sites. Essential elements of good housekeeping include:

- orderly placement of materials, tools and equipment,
- placing trash receptacles at appropriate locations for the disposal of miscellaneous rubbish;
- prompt removal and secure storage of items that are not needed to perform the immediate task at hand; and,
- awareness on the part of all employees to walk around, not over or on, equipment that may have be stored in the work area.

During the winter months, snow shovels and salt crystals should be kept on site to keep paths and work areas free of accumulated snow and ice.

5.12 Thermal Stress

Although the majority of the work is being conducted in the spring, summer and fall, it is possible that work may continue through the winter months. Therefore, the hazards of both heat and cold stress are presented in this plan.

5.11.2 Heat Stress

Types of Heat Stress

Heat related problems include **heat rash**, **fainting**, **heat cramps**, **heat exhaustion** and **heat stroke**. **Heat rash** can occur when sweat isn't allowed to evaporate, leaving the skin wet most of the time and making it subject to irritation. **Fainting** may occur when blood pools to lower parts of the body and as a result, does not return to the heart to be pumped to the brain. Heat related fainting often occurs during activities that require standing erect and immobile in the heat for long periods of time. **Heat cramps** are painful spasms of the muscles due to excessive salt loss associated with profuse sweating. **Heat exhaustion** results from the loss of large amounts of flu

and excessive loss of salt from profuse sweating. The skin will be clammy and moist and the affected individual may exhibit giddiness, nausea and headache.

Heat stroke occurs when the body's temperature regulatory system has failed. The skin is hot, dry, red and spotted. The affected person may be mentally confused and delirious. Convulsions could occur. **EARLY RECOGNITION AND TREATMENT OF HEAT STROKE ARE THE ONLY MEANS OF PREVENTING BRAIN DAMAGE OR DEATH.** A person exhibiting signs of heat stroke should be removed from the work area to a shaded area. The person should be soaked with water to promote evaporation. Fan the person's body to increase cooling.

Early Symptoms of Heat-Related Health Problems:

- decline in task performance
- incoordination
- decline in alertness
- unsteady walk
- excessive fatigue
- reduced vigilance
- muscle cramps
- dizziness

Susceptibility to Heat Stress Increases due to:

- lack of physical fitness
- lack of acclimation
- increased age
- dehydration
- obesity
- drug or alcohol use
- sunburn
- infection

People unaccustomed to heat are particularly susceptible to heat fatigue. First timers in PPE need to gradually adjust to the heat.

The Effect of Personal Protective Equipment

Sweating normally cools the body as moisture is removed from the skin by evaporation. However, the wearing of certain personal protective equipment (PPE), particularly chemical protective coveralls (e.g., Tyvek), reduces the body's ability to evaporate sweat and thereby regulate heat buildup. The body's efforts to maintain an acceptable temperature can therefore become significantly impaired by the wearing of PPE.

Measures to Avoid Heat Stress:

The following guidelines should be adhered to when working in hot environments:

- Establish work-rest cycles (short and frequent are more beneficial than long and seldom).
- Identify a shaded, cool rest area.
- Rotate personnel, alternative job functions.
- Water intake should be equal to the sweat produced. Most workers exposed to hot conditions drink less fluids than needed because of an insufficient thirst. **DO NOT DEPEND ON THIRST TO SIGNAL WHEN AND HOW MUCH TO DRINK.** For an 8-hour workday, 50 ounces of fluids should be drunk.
- Eat lightly salted foods or drink salted drinks such as Gatorade to replace lost salt.
- Save most strenuous tasks for non-peak heat hours such as the early morning or at night.
- Avoid alcohol during prolonged periods of heat. Alcohol will cause additional dehydration.
- Avoid double shifts and/or overtime.

The implementation and enforcement of the above mentioned measures will be the joint responsibility of the project manager, on-site field coordinator, and health and safety officer. Potable water and fruit juices should be made available each day for the field team.

Heat Stress Monitoring Techniques

Site personnel should regularly monitor their heart rate as an indicator of heat strain by the following method: Check radial pulse rates by using fore-and middle fingers and applying light pressure to the pulse in the wrist for one minute at the beginning of each rest cycle. If the pulse rate exceeds 110 beat/minute, shorten the next work cycle by one-third and keep the rest period the same. If, after the next rest period, the pulse rate still exceeds 110 beats/minute, shorten the work cycle by one-third.

5.12.1 Cold Stress

Types of Cold Stress

Cold injury is classified as either localized, as in frostbite, frostnip or chilblain; or generalized, as in hypothermia. The main factors contributing to cold injury are exposure to humidity and high winds, contact with wetness and inadequate clothing.

The likelihood of developing frostbite occurs when the face or extremities are exposed to a cold wind in addition to cold temperatures. The freezing point of the skin is about 30° F. The fluids around the cells of the body tissue freeze, causing the skin to turn white. This freezing is due to exposure to extremely low temperatures. As wind velocity increases, heat loss is greater and frostbite will occur more rapidly.

Symptoms of Cold Stress

The first symptom of frostbite is usually an uncomfortable sensation of coldness, followed by numbness. There may be a tingling, stinging or aching feeling in the effected area. The most vulnerable parts of the body are the nose, cheeks, ears, fingers and toes.

Symptoms of hypothermia, a condition of abnormally low body temperature, include uncontrollable shivering and sensations of cold. The heartbeat slows and may become irregular, the pulse weakens and the blood pressure changes. Pain in the extremities and severe shivering can be the first warning of dangerous exposure to cold.

Maximum severe shivering develops when the body temperature has fallen to 95° F. This must be taken as a sign of danger and exposure to cold must be immediately terminated. Productive physical and mental work is limited when severe shivering occurs.

Methods to Prevent Cold Stress

When the ambient temperature, or a wind chill equivalent, falls to below 40° F (American Conference of Governmental Industrial Hygienists recommendation), site personnel who must remain outdoors should wear insulated coveralls, insulated boot liners, hard hat helmet liners and insulated hand protection. Wool mittens are more efficient insulators than gloves. Keeping the head covered is very important, since 40% of body heat can be lost when the head is exposed. If it is not necessary to wear a hard hat, a wool knit cap provides the best head protection. A face mask may also be worn.

Persons should dress in several layers rather than one single heavy outer garment. The outer piece of clothing should ideally be wind and waterproof. Clothing made of thin cotton fabric or synthetic fabrics such as polypropylene is ideal since it helps to evaporate sweat. Polypropylene is best at wicking away moisture while still retaining its insulating properties. Loosely fitting clothing also aids in sweat evaporation. Denim is not a good protective fabric. It is loosely woven which allows moisture to penetrate. Socks with a high wool content are best. If two pairs of socks are worn, the inner sock should be smaller and made of cotton, polypropylene or a similar type of synthetic material that wick away moisture. If clothing becomes wet, it should be taken off immediately and a dry set of clothing put on.

If wind conditions become severe, it may become necessary to shield the work area temporarily. The SSO and the PM will determine if this type of action is necessary. Heated break trailers or a designated area that is heated should be available if work is performed continuously in the cold at temperatures, or equivalent wind chill temperatures, of 20° F.

Dehydration occurs in the cold environment and may increase the susceptibility of the worker to cold injury due to significant change in blood flow to the extremities. Drink plenty of fluids, but limit the intake of caffeine.

5.13 Inclement Weather

As work continues through summer in Hartford, it is important to have a response plan in place that dictates what actions ENSR employees will take in the event of severe weather, specifically severe thunderstorms and tornadoes.

When a severe thunderstorm or tornado is coming, employees will only have a short amount of time to make important decisions. ENSR employees do not have access to consistent and current news information via the television or radio when working in the field. To ensure the field team is alerted to the onset of severe weather, the project team will be issued a battery-operated National Oceanic and Atmospheric Administration (NOAA) weather radio. The radio will be equipped with

an alarm that will automatically broadcast any pertinent information from NOAA's National Weather Service. Additionally, the Hartford Police Department has notified ENSR that sirens will be activated at both the north and south end of town in the event that a tornado warning is issued for Madison County. According to the Police Department, this siren is unique in its sound (i.e. different from refinery emergency sirens).

Via the radio, the team will be aware of any severe thunderstorm and/or tornado watches or warnings that have been issued for the Hartford area by the National Weather Service. It is important for field team members to understand the difference between a "watch" and a "warning".

If a severe thunderstorm/tornado **watch** is issued for your work or travel area, it means that a severe thunderstorm/tornado is **possible**. If a severe thunderstorm/tornado **warning** is issued, it means that **a severe thunderstorm/tornado has actually been spotted or is strongly indicated on radar and it is time to seek safe shelter immediately**.

Weather broadcasts are typically issued for specific counties, not individual towns. It is important for all field team members to know that **Hartford is located in Madison County**. However, employees should also know the names of the counties through which they travel when mobilizing/demobilizing from the Hartford area, in the event that a broadcast is issued for those counties.

If a **severe thunderstorm or tornado watch** is issued, employees must remain alert for approaching storms and review the procedures for seeking refuge in the event that a warning is issued. If a **severe thunderstorm warning** is issued, ENSR employees will take the following measures:

- If working indoors, stay there until the warning passes. Stay away from windows and stay on the lower floors of the building.
- If you hear thunder, you are close enough to a storm to be struck by lightning. Cease all work and seek shelter, either a sturdy building or car, immediately. Do not take shelter in small sheds, under isolated trees or in convertible automobiles. Avoid trees as they are targets for lightning. If in a car, keep the windows up.
- If you are caught outside during a thunderstorm and no shelter is available, find a low spot away from trees, fences and poles. Squat low to the ground on the balls of your feet, place your hands on your knees with head between them. Make yourself the smallest target possible and minimize your contact with the ground.

If a **tornado warning** is issued for Madison County, ENSR employees will take the following measures:

- If located within a residence, go to the basement and stay away from the west and south walls. Hide under a heavy table or stairs to protect you from crumbling walls and large airborne debris falling into the basement. If the building has no basement, go to a windowless, interior room, such as a closet or bathroom, on the lowest floor of the building. Get under something sturdy if possible.
- If you are working outside and can not enter a resident's home, go to the pre-designated shelter areas within Hartford. According to the Hartford Police Department, these shelters include:
 - The Hartford Community Center located at the intersection of Rand and Delmar
 - Elementary school located on West 2nd
- If you are working outside and can not get inside a building quickly enough to avoid the storm, lie flat in a ditch or low spot with your hands shielding your head.
- If you are in your car, do not try to out-drive the tornado. Tornadoes can change direction and can lift up a car and toss it through the air. Get out of your car immediately and take shelter in a nearby building. If there is no time to get indoors, lie in a ditch or low-lying area away from the vehicle.

After the storm, help injured or trapped persons to the extent possible or contact 9-1-1 for assistance. All field teams must be equipped with cellular phones to ensure prompt communication with local emergency responders. Listen for the latest emergency information and obey all curfews and emergency orders. Avoid all downed power lines and stay out of damaged buildings.

5.14 Confined Space Entry

It may be necessary to place vapor barriers within the crawlspaces of the homes. A crawl space meets the definition of a confined space. Depending upon the atmosphere generated by its contents, or the physical hazards created by work performed inside the crawlspace, the crawlspace may be considered a Permit Required Confined Space that is subject to the requirements of OSHA's Permit Required Confined Spaces standard at 29 CFR 1910.146. If it becomes necessary to enter a crawlspace, air monitoring must be performed first to determine whether or not an atmospheric hazard exists within the space.

Atmospheric hazards include:

- an oxygen deficient atmosphere (i.e., < 19.5% O₂)
- a flammable atmosphere (i.e., > 10% of the LEL); or
- a toxic atmosphere (i.e., any OSHA regulated chemical at an airborne concentration above its permissible exposure limit (PEL)).

If an atmospheric hazard(s) is found to exist within the crawlspace, the contractor must comply with all aspects of 29 CFR 1910.146 including, as a minimum:

- having a written Permit Required Confined Space Program;
- utilizing employees who are formally trained as confined space entrants, attendants and supervisors;
- implementing a Confined Space Entry Permit System;
- performing the initial and ongoing atmospheric monitoring that is required to satisfy the conditions of the permit;
- providing employees who enter the space with appropriate respiratory protection, protective clothing, and equipment;
- providing for adequate communication between the entrant(s) and attendant; and,
- providing for emergency rescue services.

It is the sole responsibility of the contractor who enters the space to comply with the requirements of 29 CFR 1910.146 and the provisions of their written confined space entry program.

ENSR must receive and review the contractor's written Permit Required Confined Space Program prior to the start of the project. In addition, ENSR must receive copies of the confined space entry training records of all contractor employees that will be involved in the work. And finally, the Confined Space Entry Permit that is generated must be reviewed by the ENSR SSO before any entry takes place.

No ENSR employee should enter a confined space without the approval of the ENSR Regional Health and Safety Manager. ENSR employees who have not received formal confined space entry training must never enter a Permit Required Confined Space.

6.0 AIR MONITORING

When ENSR conducts a walk-through of each home, they perform air monitoring for the presence of the petroleum and VOC vapors, as well as monitoring for explosive atmospheres. This same monitoring protocol is followed when ENSR responds to a request from the Hartford Fire Department following a building owner's odor complaint and when ENSR performs sewer monitoring. During drilling operations, ENSR is screening soils and the work area for toxic vapors only, unless that monitoring suggests a flammable atmosphere may exist in the work area. At the same time, ENSR is also using this air monitoring data to determine employee exposure to the vapors of the contaminants of concern.

6.1 Direct Reading Instruments

Instrument 1 - Thermo Environmental Instruments TVA 1000 Toxic Vapor Analyzer

The TVA-1000 contains dual photoionization and flameionization detectors in a single instrument which allows ENSR to identify the presence of organic and inorganic vapors at the same time. The PID will detect the presence of BTEX compounds but does not respond very well to the presence of straight chain hydrocarbons and will not detect the presence of methane at all. The FID responds very well to methane and other straight chain hydrocarbons. If ENSR records a high FID reading with virtually no PID response, this might indicate the presence of methane. A high PID reading with no FID readings might suggest the presence of aromatic hydrocarbons with no methane.

For purposes of employee safety, ENSR will use the PID to determine when engineering controls and respiratory protection may need to be donned. If the PID indicates sustained (15 minute) breathing zone vapor concentrations in excess of 50 units, engineering controls, as defined in Section 7.2, will be implemented or work in this area will not be conducted. This action limit is based on the current TLV for gasoline, 300 ppm. The most toxic component of gasoline is benzene, whose current TLV is 0.5 ppm. Studies done by McDermott and Killiany in 1978 (Quest for a Gasoline TLV – AIHAJ 39:110-117, 1978) indicate that the benzene content of gasoline vapor is typically in the range of 0.4%. To assure that employee exposures to benzene remain below the current TLV of 0.5 ppm, ENSR has established an action limit of 50 ppm total VOCs (i.e. approximately 0.5 ppm/0.4%).

Instrument 2 – MSA Passport 4-way Gas Meter

Although unlikely, ENSR will be using a combustible gas indicator (CGI) to determine if explosive atmospheres are present in the basements during scheduled walk-throughs and emergency response events, as well as in the sewer systems. If an LEL is detected within a home, ENSR and other contractors, if present, will cease operations, and leave the work area, until concentrations subside. If concentrations fail to subside and work must still be performed, it will be necessary to mobilize portable ventilation equipment to the work area. Work will not resume until air monitoring confirms that the ventilation is successful in removing flammable vapors from the work area.

For sewer monitoring, the action limit for initiating engineering controls is 10% of the LEL.

6.2 Personal Air Sampling

Personal air monitoring will not be conducted at this site.

6.3 Calibration and Recordkeeping

Equipment will be used and calibrated in accordance with the manufacturer's instructions and with ENSR's standard operating procedures. The PID should be calibrated against a standard, typically 50 – 100 ppm isobutylene-in-air. The FID will be calibrated to methane. The CGI will be calibrated to a methane in air standard (i.e., 50% LEL). Detailed information on calibration procedures and the results of on-site sampling will be recorded in a project specific field notebook.

6.4 Contingency Plan Response

ENSR may perform needs assessments and/or indoor air monitoring in homes or buildings a which the Contingency Plan has been implemented. The Contingency Plan will be implemented when the Hartford Fire Department receives a petroleum vapor complaint from a Hartford resident. Prior to entering a home or building from which a complaint regarding petroleum odor was received, ENSR will contact the Hartford Fire Department and/or Illinois EPA to review any a monitoring and/or air sampling data that they have already collected during their initial response t the building. Based on this review, and any additional air sampling conducted by ENSR, th protocol outlined in the table below will be implemented by ENSR employees who may have t enter the home to perform a needs assessment and/or indoor air monitoring as part of th contingency plan response.

Contingency Plan Response

Conditions within the Building	Entry Decision
LEL readings are being reported	No entry by ENSR staff will be permitted
LEL readings have subsided to zero and total VOC readings as measured with a PID (do not use FID readings as the FID will detect the presence of methane as well as the VOCs of concern) are between 0 and 50 units	ENSR staff may enter the building without the need for respiratory protection.
LEL readings have subsided to zero and total VOC readings on the PID indicate concentrations between 50 units and 250 units	ENSR staff may enter the building but will be required to don Level C respiratory protection described in Section 7.2 of this HASP
LEL readings have subsided to zero but total VOC readings on PID exceed 250 units	No entry by ENSR staff will be permitted

7.0 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) will be worn during these activities to prevent on-site personnel from being injured by the safety hazards posed by the site and/or the activities being performed. In addition, chemical protective clothing will be worn to prevent direct dermal contact with the site's chemical contaminants. The following table describes the PPE and chemical protective clothing to be worn for general site activities and for certain specific tasks.

7.1 Chemical Protective Clothing

PPE Item	Concrete Coring	Hand Augerin g	Drilling with Geoprobe or Auger Rig	Sewer Monitoring	Foundation Sealing/ Fan Installation	Mold Removal	Needs Assessme Continger Plan Response
Hard Hat			✓	✓			
Bump Cap					In low clearance areas	In low clearance areas	In low clearanc areas
Steel Toed Safety Shoes	✓	✓	✓	✓	✓	✓	✓
Safety Glasses with Sideshields	✓	✓	✓	✓	✓		✓
Traffic Vests	If working in traffic areas	If working in traffic areas	If working in traffic areas	✓			
Safety goggles with Faceshield	✓					✓	
Work Coveralls					If site conditions warrant		If site conditic warrar
Tyvek Coveralls						✓	
Leather or Kevlar gloves	✓	✓	✓		✓		
N-Dex disposable nitrile gloves							If site conditic warra
Inner latex/Outer Nitrile gloves		when handling soils	when handling soils		When handling soils of earthen floors	✓	
Hearing Protection	✓		✓	When venting	✓		

7.2 Exposure Controls

7.2.1 Engineering Controls Inside Residence or Building

If the PID indicates sustained (15-minute) breathing zone vapor concentrations in excess of the action limit of 50 units on the PID, engineering controls will be implemented. These controls include the following:

- Opening all of the windows in the basement
- Using portable ventilation to remove the vapors from the interior work space to the exterior of the home.

Although unlikely, ENSR will be using a combustible gas indicator (CGI) to determine if explosive atmospheres are present during the installation and operation and maintenance of the pilot systems, as well as during contingency plan responses and vapor migration pathway assessments. If such conditions are detected, ENSR and other contractors, if present, will cease operations, and leave the work area, until concentrations subside. If concentrations fail to subside and work must still be performed, it will be necessary to mobilize portable ventilation equipment to the work area. Work will not resume until air monitoring confirms that the ventilation is successful in removing flammable vapors from the work area.

7.2.2 Respiratory Protection

If engineering controls can not be implemented (i.e. basements have no windows) or are unsuccessful in removing vapors from interior spaces, respiratory protection, as defined below, will be necessary. It is not expected that the action level for donning respirators will be exceeded when intrusive work is being performed exterior to the residences or other buildings. However, if the action level is exceeded, respiratory protection will be donned as the use of engineering controls in an outdoor environment is limited. Additionally, respiratory protection will be required whenever mold removal activities are implemented.

Task	Action Limit	Respiratory Protection
During installation of vent wells, monitoring points, system operation and needs assessments and contingency plan responses	50 to 250 units above background on the PID for sustained 15-minute period.	Full mask air purifying respirator with organic vapor cartridges
Mold removal activities	During entire mold removal process	Full mask air purifying respirator with organic vapor/acid gas/P100 combination cartridges

Respiratory protection should also be donned if:

- Odors become objectionable at any time or
- Respiratory tract irritation is noticed.

All employees who are expected to wear respiratory protection must have successfully passed a quantitative or qualitative fit-test within the past year.

7.3 Other Protective Equipment

ENSR will bring the following additional safety items to the site:

- Portable, hand-held eyewash bottles
- First aid kit
- Type A-B:C Fire extinguisher
- Portable ventilation equipment
- Portable communication equipment

8.0 SITE CONTROL

To prevent both exposure of unprotected personnel and migration of contamination due to tracking by personnel or equipment, hazardous work areas will be clearly identified and decontamination procedures will be required for personnel and equipment leaving those areas.

8.1 Access to Residences for Needs Assessments/Contingency Plan Response

Most of the proposed work will take place in occupied homes. Access to the homes will be coordinated with the residents through the Hartford Working Groups public affairs firm, PM & Associates. ENSR will work closely with PM & Associates to coordinate the proposed building walk-throughs and ventilation system installation.

8.2 Resident Access to Basement Areas During Installation

ENSR will attempt to restrict the residents access to the basement while active installation activities are occurring.

8.3 Designation of Zones

ENSR designates work areas or zones as suggested in the "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," NIOSH/OSHA/USCG/EPA, November 1985. They recommend that the areas surrounding each of the work areas to be divided into three zones:

- Exclusion or "hot" Zone
- Contamination Reduction Zone (CRZ)
- Support Zone

8.3.1 Exclusion Zone

Formal exclusion zones will not be established within the basement of the homes. However, ENSR will attempt to restrict the residents access to the basement while active installation activities are occurring.

Exclusion zones will be established around exterior soil boring areas. Exclusion zones should be large enough (i.e. 20 foot radius) to protect residents and their direct neighbors from any physical or chemical hazards associated with the drilling operations. Traffic cones, traffic barriers or tape will be used to demarcate these exclusion zones. All personnel entering these exclusion zones must be trained in accordance with the requirements defined in Section 10.2 of this HASP and must wear the prescribed level of personal protective equipment.

To minimize the potential impact that vehicular traffic will have on ENSR employees performing sewer monitoring activities, ENSR will erect traffic cones and barricades around the work area. If the SSO is of the opinion that these traffic control procedures are insufficient to protect ENSR employees, he will stop work and contact the PM and RHSM to implement additional traffic control options

8.3.2 Decontamination Zone

All PPE worn while working inside the home will be placed in garbage bags and removed from the home on a regular basis. Formal decontamination zones are not required when working in the basements.

A decontamination zone will be established adjacent to the exclusion zone associated with drilling operations. If they are worn, personnel will remove contaminated gloves and other disposable items in this area and place them in a plastic bag until they can be properly disposed of.

8.3.3 Support Zone for Immediate Work Areas

The support zones will include the area outside of the exclusion zone where equipment and supplies can be safely stored.

8.3.4 ENSR Office Location

ENSR has established an office trailer at the Premcor Refinery located at 201 East Hawthorne St. This office location will serve as home base for all ENSR employees and ENSR contractors working at the site.

It is possible that several project teams may be working at the site on a daily basis although each team will be working in a separate area and conducting different tasks. All ENSR employees and contractors will report directly to the office trailer, not their immediate work area, each morning. A brief planning meeting will be conducted when everyone is present to review the proposed work activities for the day and the specific work locations for each project team for that day. Each ENSR field team member and contractor will sign in to the logbook during this meeting. At the end of the day, team members will sign out. Adhering to this process is important so that in the event of a site emergency, all field team members can be accounted for.

8.4 General Site Safety Practices

The following measures are designed to augment the specific health and safety guidelines provided in this plan.

- Eating, drinking, chewing gum or tobacco, smoking or any practice that increases the probability of hand-to-mouth transfer and ingestion of materials is prohibited in the immediate work area and the decontamination zone.
- Smoking is prohibited in all work areas. Matches and lighters are not allowed in these areas.
- Hands and face must be thoroughly washed upon leaving the work area and before eating, drinking or any other activities.
- Beards or other facial hair that interfere with respirator fit are prohibited.
- The use of alcohol or illicit drugs is prohibited during the conduct of field operations.
- ENSR employees and contractors working in a BP project must not bring weapons onto the worksite.
- All equipment must be decontaminated or properly discarded before leaving the site in accordance with the project work plan.

9.0 DECONTAMINATION

9.1 Personnel Decontamination

Proper decontamination is required of all personnel before leaving an exclusion zone. All PPE worn while working inside the home will be placed in garbage bags and removed from the home on a regular basis. Formal decontamination zones are not required when working in the basements.

A decontamination zone will be established adjacent to the exclusion zone associated with drilling operations. If they are worn, personnel will remove contaminated gloves and other disposable items in this area and place them in a plastic bag until they can be properly disposed of.

Regardless of the type of decontamination system required, as a minimum, a container of potable water and liquid soap should be made available so employees can wash their hands and face before leaving the site for lunch or for the day. Employees should always wash their face and hands with soap and water before eating, smoking or drinking.

10.0 MEDICAL MONITORING AND TRAINING REQUIREMENTS

10.1 Medical Monitoring

10.1.1 HAZWOPER

All ENSR personnel and drilling staff performing activities covered by this HASP and who may be exposed to the contaminants of concern must be active participants in a medical monitoring program which complies with 29 CFR 1910.120(f). Each ENSR employee and driller must have completed an annual surveillance examination and/or an initial baseline examination within the last year prior to performing any work on the site covered by this HASP.

GRP Mechanical employees are not required to have HAZWOPER training as the tasks they are performing are not HAZWOPER-related. Therefore, they are also not required to participate in a HAZWOPER medical surveillance program. However, GRP employees must be prepared to don respiratory protection. As such, each GRP employee working on this project must be fit-tested for the respirator they will wear on this program and be medically cleared to wear such protection.

10.1.2 Drug and Alcohol Testing

All employees that perform work at this site must be involved in a drug testing program. Employees can not be assigned to field work at this site until they have completed and passed the required test. The ENSR PM is responsible for informing the subcontractor about BP's drug testing requirements.

10.2 Health and Safety Training

10.2.1 HAZWOPER

All ENSR personnel and drilling staff performing activities covered by this HASP and who may be exposed to the contaminants of concern must have completed the appropriate training requirements specified in 29 CFR 1910.120(e). Each individual must have completed an annual 8-hour refresher-training course and/or initial 40-hour training course within the last year prior to performing any work on the sites covered by this HASP.

GRP Mechanical employees are not required to have HAZWOPER training as the tasks they are performing are not HAZWOPER-related. However, GRP employees must be prepared to do

respiratory protection. As such, each GRP employee working on this project must have received respirator training.

10.2.2 Pre-Entry Briefing

Prior to the commencement of on-site activities, a pre-entry briefing will be conducted by the SSO to review the specific requirements of this HASP. Attendance of the pre-entry meeting is mandatory for all personnel covered by this HASP and must be documented on the attendance form provided in Attachment D. Copies should be maintained on site in the project files. HASP sign-off sheets should also be collected and filed at the time of the pre-entry briefing. The pre-entry briefing must be completed for each new employee before they begin work at the site.

10.2.3 Daily Safety Meetings

Daily safety meetings will be conducted by the SSO. These meetings will be documented and attendance is mandatory

10.3 Project Safety Audits

BP expects that all contractors conduct and document periodic audits and inspections of their project site. The Project Manager is responsible for ensuring that an audit is conducted during the implementation of this project. A HSE Audit checklist is attached and will be used by the PM to fulfill this BP requirement.



"Audit Inspection
Checklist.xls"

11.0 EMERGENCY RESPONSE

OSHA defines emergency response as any "response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual-aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result in an uncontrolled release of a hazardous substance." According to ENSR policy, ENSR personnel shall not participate in any emergency response where there are potential safety or health hazards (i.e., fire, explosion, or chemical exposure). ENSR response actions will be limited to evacuation and medical/first aid as described within this section below. As such this section is written to comply with the requirements of 29 CFR 1910.38 (a).

11.1 Emergency Response Training

Employees must be instructed in the specific aspects of emergency evacuation applicable to the site.

- The type(s) of potential emergencies that may occur at the facility
- The sound and meaning of the facility's emergency alarms and signals
- The escape routes and procedures for exiting the facility in the event of an emergency
- The designated place of refuge where employees should gather in the event of evacuation

11.2 Employee Accounting Method

The ENSR SSO is responsible for keeping track of all ENSR personnel on-site at all times. A representative from ENSR's subcontractor(s) should be given the same responsibility for their employees. In the event of an emergency that requires evacuation from the work area, the ENSR SSO will organize ENSR and subcontractor personnel at the place of refuge and attempt to account for all personnel that were on-site at the time of the emergency. If one or more employees are missing, the SSO should inform the local Fire Department that responds to the emergency.

11.3 Rescue and Medical Duty Assignments

The phone numbers of the police and fire departments, ambulance service, local hospital, and ENSR representatives are provided in the Emergency Reference Sheet that appears at the end of this section. In addition, this sheet also contains the directions to the nearest hospital. A copy of this sheet will be kept in ENSR's field vehicle.

In the event an injury or illness requires more than first aid treatment, the SSO will accompany the injured person to the medical facility and will remain with the person until release.

admittance is determined. The escort will relay all appropriate medical information to the on-site project manager and the RHSM.

If the injured employee can be moved from the accident area, he or she will be brought to the CRZ where their PPE will be removed. If the person is suffering from a back or neck injury the person will not be moved and the requirements for decontamination do not apply. The SSO must familiarize the responding emergency personnel about the nature of the site and the injury. If the responder feels that the PPE can be cut away from the injured person's body, this will be done on-site. If this not feasible, decontamination will be performed after the injured person has been stabilized.

11.4 Accident Reporting and Investigation

Any incident (other than minor first aid treatment) resulting in injury, illness or property damage requires an accident investigation and report. The investigation should be conducted as soon as emergency conditions are under control. The purpose of the investigation is not to attribute blame but to determine the pertinent facts so that repeat or similar occurrences can be avoided. An ENSR accident investigation form is presented in Attachment E of this HASP. The injured ENSR employee's supervisor and the RHSM should be notified immediately of the injury.

If a subcontractor employee is injured, they are required to notify the ENSR SSO. Once the incident is under control, the subcontractor will submit a copy of their company's accident investigation report to the ENSR SSO.

11.5 BP Notification of Injury/Incident

BP expects that all injuries, spills greater than 42 gallons and all property damage greater than \$500 occurring on a BP project or site will be reported to BP management immediately. These and all other incidents and near miss events, including first aid cases, are to be documented as outlined in BP's Incident Reporting Guidelines. BP expects that ENSR and its contractors will conduct, document and submit a Root Cause Analysis Investigation for all work-related injuries, illnesses, accidents and near misses. The RHSM will assist the PM in assuring that the case is reported and documented in accordance with these requirements.

EMERGENCY REFERENCES

Ambulance: 9-1-1

Fire: 9-1-1

Police: 9-1-1

Hospital: 618-463-7311

Alton Memorial Hospital
One Memorial Drive
Alton, Illinois

Directions to Hospital: From the work location, head towards Hwy 3 North. Once on Hwy 3 North, drive 4.8 miles and follow as Hwy 3 North bears right. Drive 0.3 miles and turn left onto College Avenue (Hwy 140 West). Drive 1.5 miles and turn left onto Rock Springs Drive. Drive 0.2 miles and turn right onto Memorial Drive. Drive 0.3 miles to the hospital.

ENSR Project Representatives:

ENSR/WESTFORD, MA 978-589-3000

- Kathleen Harvey (RHSM) x 3325

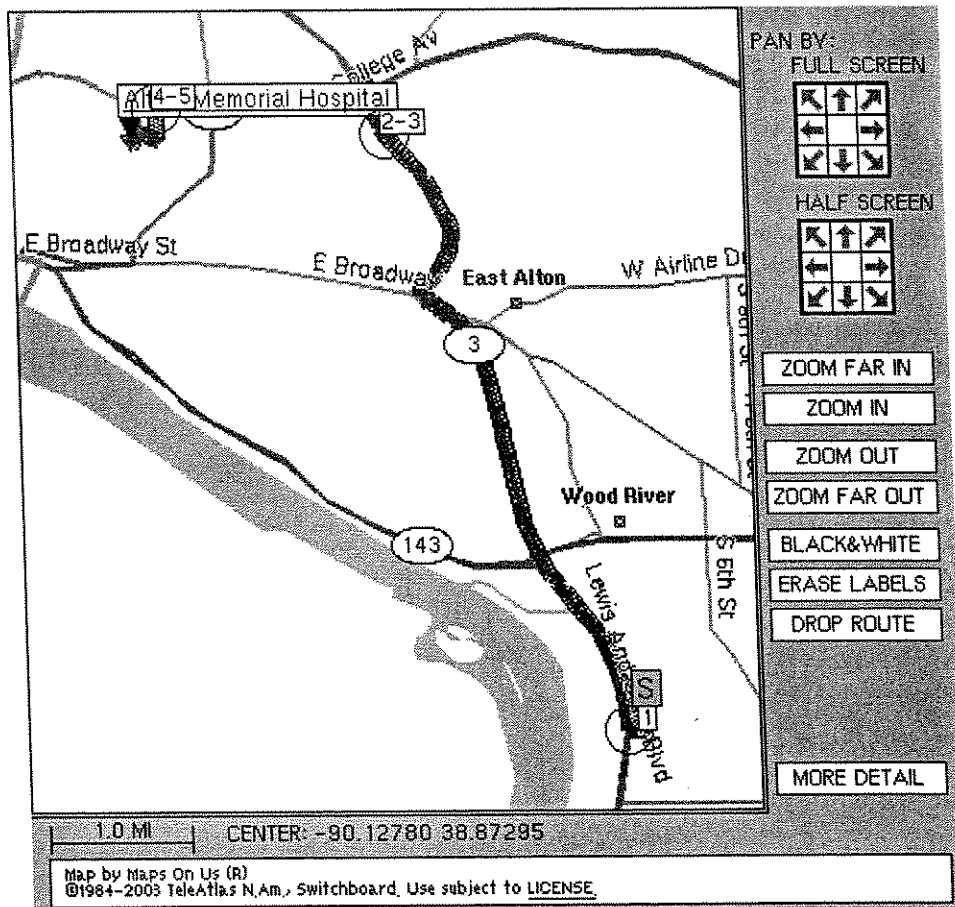
ENSR/WARRENVILLE, IL 630-836-1700

-Ralph Feeney (PM) x 323

Hartford Working Group Representatives:

John Wigger/Atlantic Richfield 630-836-7174

Map with Directions from Site to Alton Memorial Hospital One Memorial Drive - Alton, Illinois



ATTACHMENT A
BP'S GOLDEN RULES OF SAFETY

Attachment A - BP's Golden Rules of Safety

know how

BP's Golden Rules of Safety



permit to work

The Golden Rule says:

Before conducting work that involves confined space entry, work on energy systems, ground disturbance or locations where buried hazards may exist, or hot work in potentially explosive environments, a permit must be obtained that:

- defines scope of work
- identifies hazards and assesses risk
- establishes control measures to eliminate or mitigate hazards
- links the work to other associated work permits or simultaneous operations
- is authorized by the responsible personnel
- communicates above information to all involved in the work
- ensures adequate control over the return to normal operations

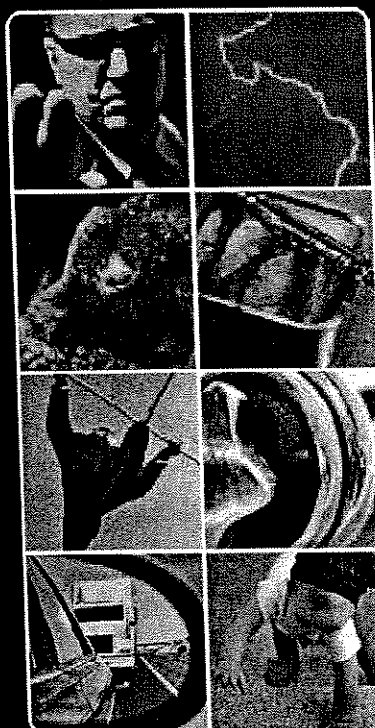


energy isolation

The Golden Rule says:

Any isolation of energy systems, mechanical, electrical, process, hydraulic, and others, carried out must:

- the method of isolation and discharge of stored energy are agreed and executed by a competent person
- any stored energy is discharged
- a system of locks and tags is utilized at isolation points
- a test is conducted to ensure the isolation is effective
- isolation effectiveness is periodically rechecked



ground disturbance

The Golden Rule says:

Work that involves a man-made pit, cavity, trench or depression in the earth's surface, formed by earth removal, carried out must:

- a hazard assessment of the work site is completed by the competent person
- all underground hazards, i.e. pipelines, electric cables, etc., have been identified, located and if necessary, isolated

Where workers are to enter an excavation:

- a confined space entry permit must be issued if the entry meets the confined space definition
- ground movement must be controlled and collapse prevented by systematically shoring, bracing, etc., as appropriate
- ground and environmental conditions must be continuously monitored for change



confined space entry

The Golden Rule says:

Entry into any confined space cannot proceed unless:

- all other options have been ruled out
- permit is issued with authorization by a responsible person
- permit is communicated to all affected personnel and posted, as required
- all persons involved are competent to do the work
- all sources of energy affecting the space have been isolated
- testing of atmosphere is conducted, verified and repeated as often as defined by the risk assessment
- stand-by person is alerted
- resuscitation and entry is prevented



working at heights

The Golden Rule says:

Working at heights of 2 metres (6 feet) or higher above the ground cannot proceed unless:

- a fixed platform is used with guard or hand rails, verified by a competent person, or:
- fall arrest equipment is used that has:
 - a proper anchor, mounted preferably overhead
 - full body harness using double latch self locking snap hooks at each connection
 - synthetic fibre webbing
 - shock absorber
- fall arrest equipment will limit free fall to 2 metres (6 feet) or less
- a visual inspection of the fall arrest equipment and system is completed and any equipment that is damaged or has been activated is taken out of service
- personnel are competent to perform the work



lifting operations

The Golden Rule says:

Lifts involving cranes, hoists, or other mechanical lifting devices will not commence unless:

- an assessment of the lift has been completed and the lift method and equipment has been determined by a competent person
- operators of powered lifting devices are trained and certified for that equipment
- rigging of the load is carried out by a competent person
- lifting devices and equipment have been certified for use within the last 12 months (at a minimum)
- load does not exceed dynamic and/or static capacities of the lifting equipment
- any safety devices installed on lifting equipment are operational
- all lifting devices and equipment have been visually examined before each lift by a competent person

Safety is a legitimate personal expectation and a constant individual responsibility.

Every member of staff should be able to go home at the end of the working day without having suffered or caused harm in any way.

In a world, and an industry, full of risks this goal can only be achieved if every single person remembers the importance of safety, accepts their personal responsibility, and knows what to do.

These simple golden rules provide basic guidance. I ask every individual to read them and to act upon them. The safety of everyone depends on our common commitment to the highest standards of care at all times and in all circumstances.



driving safety

The Golden Rule says:

All categories of vehicle, including self-propelled mobile plant, must not be operated unless:

- vehicle is fit for purpose, inspected and confirmed to be in safe working order
- number of passengers does not exceed manufacturer's design specification for the vehicle
- loads are secure and do not exceed manufacturer's design specifications or legal limits for the vehicle
- seat belts are installed and worn by all occupants
- safety helmets are worn by riders and passengers of motorcycles, bicycles, quad, snow-mobilers and similar types of vehicle

Drivers must not be authorized to operate the vehicle unless:

- they are trained, certified and adequately fit to operate the class of vehicle
- they are not under the influence of alcohol or drugs, and are not suffering from fatigue
- they do not use hand-held cell phones and radios while driving (text, push-to-talk or switch off all phones and two-way radios when driving)



management of change

The Golden Rule says:

Work arising from temporary and permanent changes to organization, personnel, systems, process, procedures, equipment, products, materials or substances, and laws and regulations cannot proceed unless a Management of Change process is completed, where applicable, (a) unless:

- a risk assessment conducted by all impacted by the change
- development of a work plan that clearly specifies the timescale for the change and any control measures to be implemented regarding:
 - equipment, facilities and process
 - operations, maintenance, inspection procedures
 - training, personnel and communication
 - documentation
- authorization of the work plan by the responsible person(s) through completion

Attachment B

Health and Safety Plan Receipt and Acceptance Form

**Health and Safety Plan Receipt and Acceptance Form
IMPLEMENTATION OF INTERIM MEASURES
HARTFORD AREA HYDROCARBON PLUME SITE
HARTFORD, ILLINOIS**

I have received a copy of the Health and Safety Plan prepared for the above-referenced site and activities. I have read and understood its contents and I agree that I will abide by its requirements.

Name (Print) _____

Signature _____ Date: _____

Representing (Print)

Company Name

ATTACHMENT C**Job Hazard Analysis Form**

PRINCIPAL STEPS	POTENTIAL HAZARDS	RECOMMENDED CONTROLS
SAFETY EQUIPMENT	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS

July 2004

Attachment D

Health and Safety Plan Pre-Entry and Daily Briefing Attendance Form

IMPLEMENTATION OF INTERIM MEASURES
HARTFORD AREA HYDROCARBON PLUME SITE
HARTFORD, ILLINOIS

Briefing Conducted By: _____

Date Performed: _____

[illegible]

Attachment E

Supervisor's Accident Investigation Report Form

SUPERVISOR'S ACCIDENT INVESTIGATION REPORTInjured Employee Job Title _____

Home Office _____ Division/Department _____

Date/Time of Accident _____

Location of Accident _____

Witnesses to the Accident _____

Injury Incurred? _____ Nature of Injury _____

Engaged in What Task When Injured? _____

Will Lost Time Occur? _____ How Long? _____ Date Lost Time Began _____

Were Other Persons Involved/Injured? _____

How Did the Accident Occur? _____

What Could Be Done to Prevent Recurrence of the Accident? _____

What Actions Have You Taken Thus Far to Prevent Recurrence? _____

Supervisor's Signature _____ Title _____ Date _____

Reviewer's Signature _____ Title _____ Date _____

Note: If the space provided on this form is insufficient, provide additional information on a separate page and attach. The completed accident investigation report must be submitted to the Regional Health and Safety Manager within two days of the occurrence of the accident.

Site Health and Safety Plan

**Investigation Plan
Village of Hartford
Hartford, Illinois**

Clayton Project No. 15-03095.14-001
January 20, 2004

Prepared for:
THE HARTFORD WORKING GROUP
Hartford, Illinois

Prepared by:
CLAYTON GROUP SERVICES, INC.
3140 Finley Road
Downers Grove, Illinois 60515
630.795.3200





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- B Tailgate Meeting Minutes Form / Health and Safety Plan Acknowledgement
- C Accident / Injury Report Form
- D Directions / Map – Route to Hospital

PROJECT NAME:

Investigation Plan

LOCATION:

Village of Hartford, Illinois

DATE PLAN APPROVED:

January 20, 2004

REVIEWER SIGNATURE:

Ken D. Comire

(Ken Comire, Clayton Group Services, Inc.)

1.0 GENERAL INFORMATION AND SCOPE OF WORK

This Site Health and Safety Plan (HASP) provides operational guidelines for Clayton Group Services, Inc. (Clayton) personnel during work to be performed for the Investigation Plan in the Village of Hartford, Illinois (Hartford). The HASP has been prepared in accordance with applicable Occupational Safety and Health Administration (OSHA) and United States Environmental Protection Agency (USEPA) guidance documents and Clayton policies.

The health and safety protocols established in this Plan are based on the site conditions and chemical hazards known and/or anticipated to be present. Chemical Hazards Response Information System (CHRIS) sheets for the constituents are provided in Attachment A. This HASP is intended for use during the specified activities. Specifications herein are subject to review and revision based on actual conditions encountered in the field.

Before site operations begin, a pre-entry safety briefing will be held, and all employees involved in these operations will have read and understood this HASP and all revisions made. At a minimum, follow-up briefings will be held at the beginning of each workweek.

1.1 PROJECT DESCRIPTION

The proposed principal field activities include:

- Cone Penetrometer Testing (CPT) and Rapid Optical Screening Tool (ROST™) investigation within Hartford with soil and groundwater sampling at selected locations.
- Well gauging in Hartford wells, Premcor refinery wells, and Shell/Tannery wells.

- Drilling and installing soil borings/monitoring wells in Hartford.
- In-situ hydraulic conductivity testing of selected monitoring wells.
- Groundwater sampling of selected monitoring wells.
- Repairs/replacement of existing monitoring wells in Hartford.
- Baildown recovery testing on selected wells in Hartford.
- Infrastructure assessment, which includes using electro-magnetic remote sensing and/or other remote sensing methods, as appropriate.
- Excavation, drilling, and associated soil sampling near identified utilities/pipelines in Hartford.
- Excavation and trenching in Hartford.

1.2 SITE DESCRIPTION AND SITE BACKGROUND

Background information regarding the vapor/free product issues in the northern portion of Hartford has been discussed in numerous reports by public and private entities.

Two of the most comprehensive reports presenting this background information are the March 1992 *History of Hydrocarbon Releases in the Village of Hartford, Illinois* prepared for Shell Oil Company by Engineering-Science and the November 1990 *Hartford Underground Hydrocarbon Investigation* prepared by the Illinois Environmental Protection Agency (Illinois EPA). A Final Release by the Illinois Department of Public Health titled *Public Health Assessment Response to Vapors in Hartford Homes, Hartford, Madison County, Illinois*, undated, was the most recent known document addressing vapor/free product issues in Hartford by others during 2002.

On behalf of the Premcor Refining Group (Premcor) Clayton recently completed a *Current Conditions Report for the Premcor Hartford Refinery and River Dock*, dated April 28, 2003 and a *Vapor Control System Evaluation of the Village of Hartford*, dated August 14, 2003.

The project area is primarily a residential neighborhood with scattered light commercial development. Hydrocarbon odor complaints have been documented in Hartford since the mid-1960s. In addition, house fires attributed to petroleum vapors entering the home have been documented since the early 1970s. Increased frequency of odor complaints and the house fires all occurred during periods of increasing or peak groundwater levels.

The hydrogeology of the Hartford vicinity consists of three aquifers that vary from unconfined to confined conditions. The aquifers consist of coarse- to fine-grained permeable sands deposited within low permeability silty clays. The deeper and thickest aquifer is known as the Main Sand. This aquifer underlies the entire area beginning at depths ranging from approximately 20 to 45 feet below ground surface (bgs). Overlying the Main Sand beneath the northeast section of Hartford are two sand intervals (the EPA Sand and the Rand Sand) interbedden with low permeability clay and silty clays. The upper seasonally saturated Rand Sand is encountered at approximately 20 feet bgs. The EPA Sand underlies the Rand Sand. The EPA Sand is separated from the Rand Sand by a clay layer that ranges in thickness from 3 to 11.5 feet. The EPA Sand and the Main Sand are hydraulically connected, while the Rand Sand is not hydraulically connected to either the EPA Sand or the Main Sand.

Past investigations conducted in Hartford show that in addition to the free phase hydrocarbons found on the water table, shallower (near-surface) soils are also contaminated with hydrocarbons.

2.0 PROJECT SAFETY REQUIREMENTS

2.1 PERSONNEL

Project Manager	Monte Nienkerk
Project Health and Safety Officer	Ken Comire
Site Health and Safety Officer	Heidi Mendygral

The site health and safety officer will have the authority and responsibility to change levels of protection and, when necessary, shut down the operation.

Personnel Roles

Project Manager

The Project Manager (PM) has primary responsibility for the completion of the project. It is the PM's duty to keep the project on schedule, and to communicate with the client regarding progress toward the specified goals.

Project Health and Safety Officer

The project health and safety officer (PHSO) has overall responsibility for establishing appropriate health and safety procedures. The PHSO must oversee operations and ensure that project requirements are met. The PHSO is responsible for documenting that employees have received proper health and safety training and have participated in a medical surveillance program.

Site Health and Safety Officer

The site health and safety officer (SHSO) is responsible for documenting that the designated procedures are implemented in the field. The SHSO should be consulted before any changes in the recommended procedures or levels of protective clothing are made. The SHSO is the onsite coordinator and overseer of operations. It is the SHSO's

duty to maintain site security, supervise the laborers and technicians, and ensure that all procedures (health and safety, decontamination, protective equipment, etc.) are followed.

2.2 EMPLOYEE TRAINING REQUIREMENTS

All Clayton operational employees participate in routine health and safety education and training programs. These programs are designed to provide Clayton employees with a thorough knowledge of hazardous materials, health and safety hazard potentials, and compliance with federal OSHA 29 CFR 1910.120 (e): 40 hours initial instruction, 8 hours refresher training annually, and EPA requirements. At a minimum, this training includes the following:

- | | |
|---|---|
| ▪ General safety rules | ▪ Fire prevention/protection |
| ▪ Basics of toxicology/physiology | ▪ First aid / CPR |
| ▪ Hazardous materials (types/characteristics) | ▪ Confined space work / safety |
| ▪ Hazard communication information | ▪ Atmospheric testing / sampling procedures |
| ▪ Respiratory training | ▪ Emergency response procedures |
| ▪ Chemical protective clothing | ▪ Electrical hazard |
| ▪ Decontamination procedures | ▪ Federal and state regulations |

Before work begins, a pre-entry safety briefing will be held. The Health and Safety Plan Acknowledgement form must be completed to document this briefing (Attachment B). Follow-up briefings will be held as needed. At a minimum, follow-up briefings will be held at the beginning of each workweek and documented with a Tailgate Meeting Minutes form.

3.0 HAZARD EVALUATION

Available data for the work area indicate potential chemical hazards may be present in various media onsite. The following summarizes the potential chemical and physical hazards associated with each planned field activity:

Field Activity	Potential Hazard
CPT/ROST™ investigation, drilling and monitoring well installation, excavation and trenching	Direct contact with contaminants in soil and groundwater; heat/cold stress; heavy machinery noise; trips, slips, and falls; inhalation or ignition of escaping vapors or gases; contact of drilling rig mast with overhead electrical lines; contact with moving parts.
Well gauging, hydraulic conductivity testing, soil and groundwater sampling	Direct contact with contaminants in soil and groundwater; heat/cold stress; trips, slips, and falls; inhalation or ignition of escaping vapors or gases

Additional hazards to be aware of include vehicular and pedestrian traffic in Hartford.

3.1 CHEMICAL HAZARDS

Contaminants that may be encountered during the activities are associated with petroleum. Specific chemicals that may be encountered can be grouped into volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals. VOCs that may be present are benzene, ethylbenzene, methyl tertiary butyl ether (MTBE), toluene, and xylene. SVOCs that may be present are acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, fluorene, naphthalene, phenanthrene, pyrene, phenol, bis(2-ethylhexyl)phthalate, and di-n-butyl phthalate. Metals that may be present are arsenic, chromium (total), lead, nickel, and vanadium. Other compounds of potential concern are cyanides (total), hydrogen sulfide, methane, and tetra-ethyl lead. Chemical data safety information is provided in Attachment A.

3.2 COLD STRESS PRECAUTIONS

When temperatures are expected to be in the 40s or lower, especially during high winds, cold stress will be considered. Cold stress presents several different syndromes: mild hypothermia and profound hypothermia, frostbite, and chilblains. The signs and symptoms of hypothermia include shivering, poor coordination, slowed pace, irritability, slurred speech, fatigue, and poor judgment. More severe hypothermia can result in stupor, collapse, and eventually death.

The signs and symptoms of frostbite include stiffness and numbness in body parts (i.e., nose, ears, toes, and fingers), and a noticeable grayish or whitish skin color.

Workers will be encouraged to wear layers of protective, insulated clothing; keep hands, head, and feet covered and warm; keep clothes dry; eat high-energy foods; and drink plenty of water.

Warm shelter will be provided out of the wind for rest periods. Crews will be encouraged to get warm and dry during lunch periods. Dehydration is a factor in hypothermia and frostbite, and will be avoided.

3.3 HEAT STRESS PRECAUTIONS

Certain precautions (described below) will be required to reduce the likelihood of heat fatigue, heat exhaustion, and heat stroke. Heat stroke, in particular, is a life-threatening condition. All employees will be alert to the symptoms of heat exhaustion, which include extreme fatigue, cramps, dizziness, headache, nausea, profuse sweating, and pale clammy skin.

Heat stroke or the stage immediately preceding it includes bright red skin, or a bluish face or conjunctiva, tremors leading to convulsions, delirium, struggling, bright red chest area, hot skin, headache, and vertigo. Collapse, unconsciousness, coma, and death may follow. Workers will be encouraged to drink liquids from the time they wake up and frequently during the workday.

3.4 PERSONAL PRECAUTIONS

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated contaminated. Smoking is allowed only in designated areas.
- Whenever decontamination procedures for outer garments are in effect, the entire body shall be thoroughly washed as soon as possible after the protective garment is removed.
- No facial hair that interferes with a satisfactory fit of the mask-to-face seal is allowed on personnel required to wear respirators.
- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, walking through puddles or discolored surfaces; kneeling on the ground; leaning, sitting, or placing equipment on drums, containers, or the ground should be avoided.
- Medicine and alcohol may aggravate the effects from exposure to toxic chemicals. Personnel should not take prescribed drugs where the potential for adsorption, inhalation, or ingestion of toxic substances may exist in the subsurface environment, unless specifically approved by a qualified physician. Alcoholic beverage intake while onsite is prohibited. Personnel must comply with the Clayton drug and alcohol policy.
- All personnel must be familiar with standard operating safety procedures and any additional instructions and information contained in this HASP.
- All personnel must adhere to the information contained in this HASP.
- Contact lenses cannot be worn when respirator protection is required or when the hazard of splash exists.

3.5 GENERAL OPERATIONS

- Site-specific requirements may be required when working within the subject area.
- All personnel entering a work site must be adequately trained and thoroughly briefed on anticipated hazards, equipment to be worn, safety practices to be followed, emergency procedures, and communications.
- Any required respiratory protective devices and clothing must be worn by all personnel going into areas designated for wearing protective equipment.
- Work areas for various operational activities must be established.
- All electrical equipment (power tools, extension cords, etc.) shall conform to OSHA 29 CFR 1926.400 Subpart K.
- Frequent and regular inspections of site operations will be conducted to ensure compliance with this HASP. If any changes in operation occur, this HASP will be modified to reflect changes.
- All first aids and injuries must be immediately reported to the SHSO.

3.6 DRILLING/ EARTH MOVING / EXCAVATION OPERATIONS

Heavy machinery will be present during drilling, earthmoving, excavation, and trenching activities; particular care will be maintained to avoid accidents. Many opportunities for accidents exist while working near these types of equipment. The contractor will comply with the requirements specified in 29 CFR 1926, Subpart "O" and "P."

The area utility locator will be contacted to locate all suspected utility lines. Drilling near the electrical power lines, either overhead or buried, requires special precautionary measures by all involved in site work operations.

The SHSO, drilling, and earthmoving/excavation subcontractor's foreman is responsible for ensuring that the necessary equipment and work site are ready for safe working

conditions. They are also responsible for ensuring that the safe working procedures summarized below are followed.

- All equipment will be operated by qualified personnel following general safe operating procedures in terms of equipment tolerance, clearance, capacities, etc.
- Equipment shall be maintained properly and periodically inspected to ensure safe operation.
- Unauthorized persons will not be allowed within the limits of operations while any activities are going on.

3.7 CONFINED SPACE ENTRY

Any excavation site will be reclassified as a permit-required confined space. This will require the following array of requirements:

- Continuous ventilation of the excavation.
- Full-time attendant outside the excavation monitoring work inside the excavation.
- Posting the area as Permit-Required Confined Space.
- Lifelines attached to workers inside the excavation (tied to the excavating equipment as a means of retrieving workers in the excavation should they become unconscious).

Prior to any worker entering the excavation, Clayton will conduct air sampling for hydrogen sulfide, percent oxygen concentration, and lower explosive limits. Monitors will be equipped with an extended probe to allow monitoring from a location outside the excavation. After a safe atmosphere has been established and documented as listed below, the workers may enter the excavation. The workers entering the excavation will wear a portable gas monitor (for lower explosive limit [LEL], oxygen, and hydrogen

sulfide) with alarms at all times. Excavations will be evacuated any time the following levels are exceeded:

- Oxygen content less than 19.5% or more than 25%
- Hydrogen sulfide levels in excess of 5 parts per million (ppm)
- LEL of 5%

Should continuous air monitoring indicate a hazardous atmosphere, employees will immediately evacuate the trench and not allow entry until the hazards have been eliminated using ventilation.

3.8 PERSONAL PROTECTIVE EQUIPMENT

3.8.1 Criteria for Levels of Protection

Based on photoionization detector (PID) readings in the breathing zone, the criteria for levels of protection are as follows:

Level D	Background
Level C	(1) Atmospheric contaminant concentrations do not exceed Immediately Dangerous to Life and Health (IDLH) levels; (2) air concentrations of identified substances will be reduced by the respirator to below the substance's exposure limit; (3) service limit of respirator cartridges will not be exceeded; (4) atmosphere contains 19.5 to 21.5 percent oxygen; (5) atmosphere contains less than 10 ppm hydrogen sulfide; and (6) atmosphere contains no greater than 5 ppm total VOCs above background.
Level B	(1) Atmosphere with chemical concentrations considered IDLH; (2) atmosphere exceeding limits of protection afforded by respirators; (3) atmosphere contains substances with poor warning properties; (4) atmosphere contains less than 19.5 percent oxygen; and (5) atmosphere contains no greater than 50 ppm VOCs above background.

It is anticipated that Level D personal protection will be used for all planned work.

3.8.2 Safety Equipment Associated with Levels of Protection

Level D

- Coveralls, (Optional)
- Boots, steel-toe
- Boots (outer), disposable (optional)
- Hard hats
- Protective gloves
- Goggles or safety glasses

Level C

- Full-face, air-purifying respirator with suitable cartridges
- Chemical-resistant suit (overalls & long-sleeved jacket; or polycoated, disposable, chemical-resistant coveralls)
- Gloves (inner) surgical latex
- Gloves (outer) chemical-resistant (taped to sleeves)
- Boots (inner) steel-toe
- Boots (outer), disposable (taped to cuffs)
- Hard hat
- Coveralls

Level B

- Positive pressure-demand Self-Contained Breathing Apparatus (SCBA)
- Five-minute air pack
- Chemical-resistant splash suit (overalls & long-sleeved jacket; or polycoated, disposable, chemical-resistant coveralls)
- Gloves (inner) surgical latex
- Gloves (outer) chemical-resistant (taped to sleeves)
- Boots (inner) chemical-resistant, steel-toe
- Hard hat
- Coveralls
- Disposable boot & glove covers (optional)

Air monitoring will be performed in order to ensure that appropriate engineering controls and personal protective equipment are adequate for the tasks being performed. During activities in which atmospheric monitoring is required, a PhD Lite Gas Detector or equivalent meter and a PID with a 10.2 eV lamp will be used. Most potentially hazardous VOCs are readily detectable with a PID instrument. In addition, the PhD Lite Gas Detector will be used to monitor LEL, oxygen (O₂), hydrogen sulfide (H₂S) and carbon monoxide. Direct-reading air monitoring instruments will be calibrated at the beginning of each day and as required by the manufacturer. Calibration procedures for field screening instruments are described in the equipment operation manuals carried with the instruments.

The action limits for work stoppage and evacuation are a PID reading greater than 10 ppm continuous reading or greater than 50-ppm instantaneous peak; an explosive gas concentration greater than 20 percent of the LEL in the general work area; a H₂S reading greater than 5 ppm. These action levels, along with the fact that these activities will be conducted in open areas, will provide appropriate protection against anticipated hazards.

3.9 ACTION LEVELS

Unless otherwise stated, the following action levels are for the breathing zone.

BREATHING ZONE ACTION LEVELS		
Instrument	Action Level	Specific Action
PID ⁽¹⁾	5 ppm above background continuous reading.	Don respirators, equipped with combination organic vapor/acid gas cartridges (LEVEL C).
PID ⁽¹⁾	> 10 ppm continuous reading or > 50 ppm instantaneous peak.	Evacuate the work area, allow to vent for 10 minutes and then monitor again. If still above Action Level, evacuate area and contact SHSO.
PhD Lite Gas Detector	LEL > 10 % at the borehole	Exercise caution.
PhD Lite Gas Detector	LEL > 20 % at the borehole	Continuously monitor immediate work area.
PhD Lite Gas Detector	LEL > 20 % in general work area	Evacuate the work area, allow to vent for 10 minutes and then monitor again. If still above Action Level, evacuate area and contact SHSO.
PhD Lite Gas Detector	H ₂ S ≤ 5 ppm	Exercise caution.
PhD Lite Gas Detector	H ₂ S > 5 ppm peak	Evacuate the area, allow to vent for 10 minutes and then monitor again. If still above Action Level, evacuate area and contact SHSO.
<p>* NIOSH Pocket Guide to Chemical Hazards, U.S. Dept. of Health and Human Services, June 1997.</p> <p>(1) PID will be calibrated to 100-ppm isobutylene a minimum of twice during each working day.</p>		

All air monitoring readings will be documented in an air monitoring data sheet or in the field logbook.

Respirators may be removed once air monitoring indicates respiratory protection is no longer necessary (i.e., the action levels are no longer exceeded).

If the action levels for work area evacuation are exceeded, work will be suspended in the immediate vicinity of the borehole or work area for 10 minutes in order to allow the area to vent. After the 10-minute venting period, air in the breathing zone will be monitored by a Clayton field supervisor wearing a respirator by approaching the work area from the upwind direction. If the PID and the PhD Lite Gas Detector indicate organic vapor concentrations and combustible gas levels are less than the action levels, work will continue; otherwise, the work area will be allowed to vent for 10 additional minutes, and the process will be repeated.

If air-monitoring results in the breathing zone continue to exceed the evacuation action limits, the work area will be evacuated. Site conditions will be re-evaluated, and preparations for an upgrade of protection to Level B will be made.

If the SHSO determines a hazard exists due to airborne dust or other particulates, respirators will be donned by field personnel.

3.10 HEALTH SURVEILLANCE PROGRAM

All Clayton employees involved with this project will participate in a health surveillance program under the direction of an occupational physician. This program will include a pre-employment medical examination and an annual examination. Periodic follow-up medical examinations are conducted as needed to assess the health status of individual workers based on the kinds of work and exposures encountered by the individual. Each physical examination consists of the following elements:

- Review of personal and family health history
- Cardiovascular risk analysis
- Daily pressure questionnaire
- Complete physical examination
- Eye test: (near and distant vision, color vision, peripheral vision, depth perception)
- Electrocardiogram, 12 lead
- Detailed blood and urine analyses
- Gastrointestinal (GI) system
- Genitourinary disorders
- Pulmonary function study (functional lung capacity)

As noted above, a pulmonary function study is performed on each employee to determine if he/she is physically able to perform work while using respiratory protective equipment in compliance with OSHA 29 CFR 1910.134 and ANSI Z88.2 -1980.

Clayton employee medical records are maintained at company offices and at the Health Company conducting the testing and physicals.

A First Aid kit meeting OSHA requirements (29 CFR, Subpart D, Section 1926.50 and ANSI Z308.1 - 1978) will be available in a support vehicle during all fieldwork.

4.0 AIR MONITORING PROTOCOL

All monitoring will be conducted in accordance with the accepted practices utilized in the industry.

A PID with a 10.2 eV probe or equivalent will be used to monitor ambient air conditions at the site during field operations. An operations and troubleshooting manual for the PID will be kept onsite during all fieldwork. The PID will be checked for proper calibration a minimum of twice daily and, as necessary, during the course of operations. Calibration results will be recorded in an air monitoring data sheet or in the field logbook.

A PhD Lite Gas Detector equipped with sensors for oxygen, LEL, and hydrogen sulfide will be used to monitor for gases. The detector will be calibrated on a daily basis with the results recorded in an air monitoring data sheet or in the field logbook.

5.0 SITE CONTROL

5.1 SITE COMMUNICATION

Field investigators shall use the following signals when voice communication is not possible.

- Waving hand toward the body in a “come here” gesture – COME HERE.
- Pushing one or both hands away from the body in a “back up” gesture - BACK UP.
- Extending both arms directly in front of the torso at shoulder level, hands open, palms forward, and stopping them abruptly – STOP RIGHT WHERE YOU ARE.
- Throwing the right clenched fist with extended right thumb abruptly over the right shoulder in a “let’s get out of here” gesture – LET’S GET OUT OF HERE.
- Thumbs up – YES/EVERYTHING’S OKAY.
- Thumbs down – NO/THIS DOESN’T LOOK GOOD.
- Hands grasping throat – I’M CHOKING/OUT OF AIR.
- Hands on top of head – I NEED ASSISTANCE.

5.2 SAFETY ZONES AND ACCESS CONTROL

Should it become necessary to upgrade above Level D, control boundaries for site work will be established and will consist of the Exclusion Zone, the Decontamination Zone, and the Clean Zone. The following is a description of each control zone:

- The Exclusion Zone (contaminated area) will be the area within 10 feet around the work area.

- The Decontamination Zone (contamination reduction where decontamination takes place) will be the area from the perimeter of the Exclusion Zone to a 25-foot radius.
- The Clean Zone (support area where workers should not be exposed to hazardous conditions) will be the area beyond the Decontamination Zone.

Movement of equipment and personnel among these zones should be minimized to prevent cross-contamination from contaminated areas to clean zones.

Site personnel will be briefed by the SHSO as to the location of work areas and Exclusion Zones, decontamination areas, telephones, fire extinguishers, prevailing wind direction, power lines (if not marked onsite), and first aid kits.

Potable water for health and safety procedures and decontamination procedures will be brought to the site as needed by site personnel and will be available in the Decontamination Zone and Clean Zone.

5.3 SPECIFIC DECONTAMINATION PROCEDURES

All work will be performed in Level D personal protection, and no personal decontamination area will be set up. Should conditions change at the site causing an upgraded level of protection, a decontamination area will be established and all workers informed of the necessary procedures.

While in Level D, all disposable protective clothing will be disposed of as general refuse. Decontamination of equipment will take place on designated areas if necessary. If an upgrade to Level C occurs, all nondisposable protective equipment will be cleaned in a specified contaminant reduction zone before leaving the site. The protective equipment will be cleaned with a detergent wash and rinsed with distilled water.

6.0 CONTINGENCY PLAN AND EMERGENCY PROCEDURES

When working within or in association with a refinery, the facility has safety regulations that all contractors and personnel must obey. Injuries must be reported to the SHSO and appropriate refinery personnel. An accident/injury form must be completed (Attachment C). Copies of the route to the hospital will be kept in all site vehicles. Emergency telephone numbers will be posted near each available telephone.

In case of an emergency, dial 911 (or "O" on a cellular telephone) and send someone out to the front of the facility (if warranted) to meet the emergency personnel.

Illinois Emergency Management Agency (IEMA)	1-800-782-7860 (spills)
Alton Memorial Hospital	(618) 463-7300
Police	911 or "O" on a cellular phone
Fire	911 or "O" on a cellular phone
Illinois EPA Emergency Response Unit	(217) 782-3637
Poison Control Center	(800) 942-5969
Premcor Contact	Steve Haug (618) 254-7301 Ext. 530 Cell: (618) 779-3069
Clayton Contact	Monte Nienkerk or Ken Comire (630) 795-3200

6.1 ROUTE TO HOSPITAL

To Alton Memorial Hospital (General): From the Village of Hartford head west to Illinois 3 North. Turn right on Illinois 3 North (3.4 miles) continuing on East Broadway Street (2.2 miles) – this turns into East 4th Street (0.1 miles). Finally, turn right on Pearl Street. After traveling 0.2 miles on Pearl Street, turn right onto Park Drive, and then an immediate right on East Drive. Turn left at Rock Springs Drive, and continue for 0.6 miles to Alton Memorial Hospital.

For a printout of the directions and a map of the route to hospital, see Attachment C.

6.2 FIRST AID PROCEDURES

Inhalation:	Remove to fresh air. If breathing has stopped, restore breathing through artificial respiration.
Skin Contact:	Flush exposed area with water. Wash area thoroughly with soap and water. Remove all contaminated clothing and footwear.
Eye Contact:	Flush immediately with large amounts of water, lifting upper and lower lids occasionally. Continue flushing for at least 15 minutes.
Ingestion:	Do not induce vomiting. If vomiting occurs spontaneously, keep person's head below hips to prevent inhalation.

6.3 MEDICAL PROCEDURES

Should any Clayton personnel visiting or working at the facility be injured or become ill, **notify the SHSO** and initiate the following emergency response plan:

***Note:** The anticipated nature of chemical contamination on this project does not present an immediate threat to human health. Other than removal of outer garments and gross contamination, immediate emergency treatment of injuries will take precedence over rigorous personal decontamination.*

- If able, the injured person will proceed to the nearest available source of first aid. Remove soiled outer garments and, if necessary, wash the injured area with soap and water.
- If the injury involves foreign material in the eyes, immediately flush the eyes with emergency eyewash solution and rinse with copious amounts of water at the nearest emergency eyewash station. Obtain or administer first aid as required. If further medical treatment is required, seek medical assistance as discussed below.
- If the victim is unable to walk, but is conscious and there is no evidence of spinal injury, escort or transport the injured person to the nearest first aid facility. If the

victim cannot be moved without causing further injury, such as in the case of a severe compound fracture, take necessary emergency steps to control bleeding and immediately call for medical assistance as discussed below.

- If the victim is unconscious or unable to move, **do not move the injured person unless absolutely necessary to save his or her life** until the nature of the injury has been determined.
- If there is any evidence of spinal injury, do not move the victim. Administer CPR if the victim is not breathing, control severe bleeding, and **immediately call 911 (or the operator on a cellular telephone) and advise them of the situation**. Otherwise, seek medical assistance as discussed below.
- If the victim is not breathing, administer artificial respiration. If the victim has no pulse, administer CPR. Control severe bleeding upon determination that the victim has a pulse and is breathing.
- If the injury to the worker is related to the physical hazards previously identified, appropriate first-aid procedures will be instituted as follows:

Hypothermia

If a worker suffers from hypothermia, medical attention will be sought immediately. The employee will be moved out of the cold, and warm clothing or blankets will be provided. Warming will take place slowly; no food or beverage will be administered.

Frostbite

Any worker suffering from frostbite will be moved to a warm area immediately. Frostbitten areas of the body will be placed in warm (100 to 105 degrees) water, NOT hot water. Areas of concern will be handled gently and will not be rubbed or massaged. If toes or fingers are affected, gauze will be placed between them after warming them. The injured parts will be loosely bandaged. If the part has been thawed and refrozen, it will be rewarmed at room temperature. If necessary, medical assistance will be sought.

Heat Stroke

If a worker suffers a heat stroke, **medical attention will be sought immediately**. The victim will be moved out of the heat and into a cooler area. **The victim will be cooled as quickly as possible** by immersing him or her in a cool bath, or wrapping wet sheets around the body. While waiting for an ambulance to arrive, the victim will be watched for symptoms of shock. Nothing will be given orally.

Heat Exhaustion

If any worker suffers from heat exhaustion, he or she will be moved out of the heat and into a cooler place. The victim will lie down with his or her feet up. Clothing will be removed or loosened, and cold packs, wet towels, or sheets will be used to cool the skin. One-half glass of water will be administered every 15 minutes if the victim is fully conscious and can tolerate it. During all of these procedures, the victim will be observed for symptoms of shock. If the victim has not recovered within a half-hour, or if the victim's condition worsens, medical attention will be sought.

- If further medical treatment is required and

The injury is not severe, contact Alton Memorial Hospital (618)-463-7300, and take the injured party to the hospital by private automobile.

The injury is severe, immediately call for Premcor emergency personnel.

- The SHSO will accompany the injured person to ensure prompt and proper medical attention. After proper medical treatment has been obtained, the SHSO will prepare a written report.

6.4 EMERGENCY RESPONSE PLAN

6.4.1 General

This section provides basic steps required in case of emergencies such as fire, explosion, chemical spill, and weather-related situations. If any of the above events occur, contact the SHSO immediately. The SHSO will contact the appropriate emergency personnel. In general, the following steps will be taken:

1. Determine if site evacuation is necessary. If site evacuation is required, the SHSO will notify all Clayton personnel onsite.
2. Shut down all equipment that is causing or could contribute to the emergency.
3. Attempt to safely resolve the emergency.
4. Contact other local authorities, if necessary (e.g., Police, Village of Hartford).

6.4.2 Fire or Explosion

In the case of fire or explosion, contact the SHSO immediately. Assess the situation and respond accordingly. If there is any doubt about extinguishing a fire, if present, contact the fire department immediately.

6.4.3 Chemical Spill

In case of a chemical spill, immediately contact the SHSO and take steps to stop the source of the spill, if it is safe to do so. Attempt to limit the migration of the spill using physical barriers such as soil berms. Take steps to prevent the spill from entering sewer catch basins.

6.4.4 Weather-Related Emergencies

In the case of severe weather conditions, seek shelter inside the facility. If a tornado is sighted or conditions are favorable for a tornado, go to the rest room and sit on the floor facing the wall with your head tucked between your legs and your arms over your head. Stay away from glass windows. After the severe weather conditions have subsided, take a head count and conduct a search for all missing employees.

6.5 ONSITE SAFETY EQUIPMENT

A portable fire extinguisher, a First Aid Kit, eye wash bottles, and traffic cones or caution tape are maintained at the site.

6.6 SPILL CONTAINMENT PROGRAM

Spills requiring a written spill containment program are not anticipated for the activities.

FIGURE

ATTACHMENT A

CHRIS SHEETS

ARSENIC

ARX

CAUTIONARY RESPONSE INFORMATION

Common Synonyms Arsenic, metallic Arsenic, solid Gray arsenic	Solid crystals Gray Soluble in water.
<p>AVOID CONTACT WITH SOLID AND DUST. KEEP PEOPLE AWAY. Wear self-contained positive pressure breathing apparatus and full protective clothing. Stay upwind and use water spray to "knock down" dust. Stop discharge if possible. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
Fire	Can be heated to burn in air. POISONOUS GASES ARE PRODUCED IN FIRE. Wear self-contained positive pressure breathing apparatus and full protective clothing. Extinguish small fires: dry chemical, carbon dioxide, water spray or foam; large fires: water spray, fog or foam.
Exposure	<p>CALL FOR MEDICAL AID DUST. POISONOUS IF INHALED. Move victim to fresh air. IF IN EYES OR ON SKIN, immediately flush with running water for at least 15 minutes; hold eyelids open if necessary. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>SOLID POISONOUS IF SWALLOWED. IF IN EYES OR ON SKIN, flush with running water for at least 15 minutes; hold eyelids open if necessary. IF SWALLOWED and victim is CONSCIOUS and has not vomited, induce vomiting with syrup of ipecac. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.</p>
Water Pollution	Effects of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge

2. CHEMICAL DESIGNATIONS

- 2.1 CG Compatibility Groups: Not listed
- 2.2 Formula: As
- 2.3 IACQUIN Designation: 8.1/1558
- 2.4 DOT ID No.: 1558
- 2.5 CAS Registry No.: 7440-38-2
- 2.6 HAZARD Guide No.: 152
- 2.7 Standard Industrial Trade Classification: 33499

1. HEALTH HAZARDS

- 3.1 Personal Protective Equipment: Wear self-contained positive pressure breathing apparatus and full protective clothing.
- 3.2 Symptoms Following Exposure: Poisonous by inhalation of dust or by ingestion. Regardless of exposure route, symptoms in most cases are characteristic of severe gastro or gastroenteritis. All chemical forms of arsenic eventually produce similar toxic effects. Symptoms may be delayed.
- 3.3 Treatment of Exposure: Get medical attention after any exposure to this metal. **INHALATION:** Move victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. **EYES OR SKIN:** immediately flush with running water for at least 15 minutes; hold eyelids open if appropriate. Use soap and water to clean skin. Remove and isolate contaminated clothing and shoes. **INGESTION:** If the victim is alert and has not vomited, induce vomiting with syrup of ipecac.
- 3.4 TLV-TWA: 0.01 mg/m³
- 3.5 TLV-STEL: Not listed.
- 3.6 TLV-Ceiling: Not listed.
- 3.7 Toxicity by Ingestion: Currently not available.
- 3.8 Toxicity by Inhalation: Currently not available.
- 3.9 Chronic Toxicity: Human carcinogen. Causes mutagenic, reproductive and teratogenic effects along with damage to the gastrointestinal tract and degeneration of the liver and kidneys.
- 3.10 Vapor (Gas) System Characteristics: Currently not available.
- 3.11 Liquid or Solid Characteristics: Currently not available.
- 3.12 Odor Threshold: Currently not available.
- 3.13 LDH Values: 5 mg/m³
- 3.14 OSHA PEL-TWA: 0.01 mg/m³
- 3.15 OSHA PEL-STEL: Not listed.
- 3.16 OSHA PEL-Ceiling: Not listed.
- 3.17 EPA AEGL: Not listed.

4. FIRE HAZARDS

- 4.1 Flash Point: Not pertinent
- 4.2 Flammable Limits in Air: Not pertinent
- 4.3 Fire Extinguishing Agents: Small fires: dry chemical, carbon dioxide, water spray or foam; large fires: water spray, fog or foam.
- 4.4 Fire Extinguishing Agents Not to Be Used: Not pertinent
- 4.5 Special Hazards of Combustion Products: Contains highly toxic arsenic trioxide and other forms of arsenic. Arsenic gas, the most dangerous form of arsenic, is produced upon contact with an acid or acid fumes.
- 4.6 Behavior in Fire: Burns to produce dense white fumes of highly toxic arsenic trioxide.
- 4.7 Auto Ignition Temperature: Not pertinent
- 4.8 Electrical Hazards: Currently not available
- 4.9 Burning Rate: Not pertinent
- 4.10 Adiabatic Flame Temperature: Currently not available
- 4.11 Stoichiometric Air to Fuel Ratio: Currently not available
- 4.12 Flame Temperature: Currently not available
- 4.13 Combustion Heat Rate (Reactant to Products): Currently not available
- 4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

- 5.1 Reactivity with Water: No reaction
- 5.2 Reactivity with Common Materials: Incompatible with acid, oxidizing agents, and chemically active metals
- 5.3 Stability During Transport: Stable
- 5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
- 5.5 Polymerization: Not pertinent
- 5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

- 6.1 Aquatic Toxicity: Currently not available
- 6.2 Wastewater Toxicity: Currently not available
- 6.3 Biological Oxygen Demand (BOD): None
- 6.4 Food Chain Concentration Potential: Bioaccumulated by fresh water and marine aquatic organisms.
- 6.5 GESAMP Hazard Profile: Bioaccumulation: 0
Damage to living resources: (2)
Human Oral hazard: 2
Human Contact hazard: 0
Reduction of amenity: XXX

7. SHIPPING INFORMATION

- 7.1 Grades of Purity: Crude, 90-95%; Refined, 99%
Semiconductor, 99.999%
- 7.2 Storage Temperature: Ambient
- 7.3 Inert Atmosphere: Not listed
- 7.4 Venting: Not pertinent
- 7.5 IMO Pollution Category: Currently not available
- 7.6 Ship Type: Currently not available
- 7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

- 8.1 49 CFR Category: Poison
- 8.2 49 CFR Class: 5.1
- 8.3 49 CFR Package Group: II
- 8.4 Marine Pollutant: No
- 8.5 HPLA Hazard Classification:

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	2
Instability (Yellow)	0
- 8.6 EPA Reportable Quantity: 1
- 8.7 EPA Pollution Category: X
- 8.8 RCRA Waste Number: Not listed
- 8.9 EPA FVPCA List: Not listed

9. PHYSICAL & CHEMICAL PROPERTIES

- 9.1 Physical State at 15° C and 1 atm: Solid
- 9.2 Molecular Weight: 74.9218
- 9.3 Boiling Point at 1 atm: 1,133°F = 613°C = 388°K (sublimes)
- 9.4 Freezing Point: Not pertinent
- 9.5 Critical Temperature: 1477.4°F = 803°C = 1078.2°K
- 9.6 Critical Pressure: 5027.4 psi = 342.0 atm = 34.8 MN/m²
- 9.7 Specific Gravity: 5.727 at 25°C (solid)
- 9.8 Liquid Surface Tension: Not pertinent
- 9.9 Liquid Water Interfacial Tension: Not pertinent
- 9.10 Vapor (Gas) Specific Gravity: Not pertinent
- 9.11 Rate of Specific Heats of Vapor (Gas): Not pertinent
- 9.12 Latent Heat of Vaporization: Not pertinent
- 9.13 Heat of Combustion: Not pertinent
- 9.14 Heat of Decomposition: Not pertinent
- 9.15 Heat of Solution: Not pertinent
- 9.16 Heat of Polymerization: Not pertinent
- 9.17 Heat of Fusion: Currently not available
- 9.18 Limiting Value: Currently not available
- 9.19 Reid Vapor Pressure: Currently not available

NOTES

ARSENIC

ARX

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoises
	NOT PERTI- NENT		NOT PERTI- NENT		NOT PERTI- NENT		NOT PERTI- NENT

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	INSOL- UBLE		NOT PERTI- NENT		NOT PERTI- NENT		NOT PERTI- NENT

BENZENE

BNZ

CAUTIONARY RESPONSE INFORMATION

Common Synonyms	Watery Liquid	Colorless	Gasoline-like odor
Benzol Benzene	Floats on water. Flammable, irritating vapor is produced. Freezing point is 42°F.		
<p>Respiratory actions: Avoid contact with liquid and vapor. Wear goggles and self-contained breathing apparatus. Shut off ignition sources and call fire department. Stay upwind and use water spray to "knock down" vapor. Notify local health and pollution control agencies. Protect water intakes.</p>			
Fire	<p>FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>		
Exposure	<p>CALL FOR MEDICAL AID.</p> <p>VAPOR Irritating to eyes, nose and throat. If inhaled, will cause headache, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.</p>		
Water Pollution	<p>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>		

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collect System: Stop
Chemical and Physical Treatment: Burn
Salvage: extract

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: 32; Aromatic Hydrocarbon
2.2 Formula: C₆H₆
2.3 IMO/UN Designation: 2.21114
2.4 DOT ID No.: 1114
2.5 CAS Registry No.: 71-43-2
2.6 NAERG Guide No.: 130
2.7 Standard Industrial Trade Classification: 3112

3. HEALTH HAZARDS

- 3.1 Personal Protective Equipment: Self contained positive pressure breathing apparatus; protective gloves and clothing.
- 3.2 Symptoms Following Exposure: Dizziness, excitation, pallor, followed by flushing, weakness, headache, loss of pressure, chest constriction, nausea, and vomiting. Coma and possible death.
- 3.3 Treatment of Exposure: SKIN: Flush with water followed by soap and water; remove contaminated clothing and wash skin. EYES: Flush with plenty of water until irritation subsides. INHALATION: remove from exposure immediately. Call a physician. IF breathing is irregular or stopped, start resuscitation, administer oxygen.
- 3.4 TLV-TWA: 0.5 ppm
- 3.5 TLV-STEL: 2.5 ppm
- 3.6 TLV-Ceiling: Not listed
- 3.7 Toxicity by Ingestion: Grade 3; LD₅₀ = 50 to 500 mg/kg
- 3.8 Toxicity by Inhalation: Currently not available.
- 3.9 Chronic Toxicity: Leukemia.
- 3.10 Vapor (Gas) Irritant Characteristics: If present in high concentrations, vapors may cause irritation of eyes or respiratory system. The effect is temporary.
- 3.11 Liquid or Solid Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smothering and suffocation of the skin.
- 3.12 Odor Threshold: 4.58 ppm
- 3.13 IDLH Value: 500 ppm
- 3.14 OSHA PEL-TWA: 1 ppm
- 3.15 OSHA PEL-STEL: 5 ppm
- 3.16 OSHA PEL-Ceiling: Not listed
- 3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

- 4.1 Flash Point: 12°F C.C.
- 4.2 Flammable Limits in Air: 1.3%-7.5%
- 4.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide.
- 4.4 Fire Extinguishing Agents Not to Be Used: Water may be ineffective.
- 4.5 Special Hazards of Combustion Products: Not pertinent.
- 4.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
- 4.7 Auto Ignition Temperature: 1087°F
- 4.8 Electrical Hazard: Class I, Group 0
- 4.9 Burning Rate: 5.3 mm/min
- 4.10 Adiabatic Flame Temperature: Currently not available
- 4.11 Stoichiometric Air to Fuel Ratio: 33.7 (C₆H₆)
- 4.12 Flame Temperature: Currently not available
- 4.13 Combustion Heat Rate (Reactant to Product): 9.0 (C₆H₆)
- 4.14 Minimum Oxygen Concentration for Combustion (MOC): Not listed

5. CHEMICAL REACTIVITY

- 5.1 Reactivity with Water: No reaction.
- 5.2 Reactivity with Common Materials: No reaction.
- 5.3 Stability During Transport: Stable.
- 5.4 Neutralizing Agents for Acids and Caustics: Not pertinent.
- 5.5 Polymerization: Not pertinent.
- 5.6 Inhibitor of Polymerization: Not pertinent.

6. WATER POLLUTION

- 6.1 Aquatic Toxicity: 5 ppm 96 hr LC50/TL₅₀ water 20 ppm/24 hr LC50/TL₅₀ water
- 6.2 Waterborn Toxicity: Currently not available
- 6.3 Biological Oxygen Demand (BOD): 1.2 B₅D, 10 days
- 6.4 Food Chain Concentration Potential: None.
- 6.5 GESAMP Hazard Profile: Bioaccumulation: 0
Damage to living resources: 2
Human Oral hazard: 1
Human Contact hazard: 0
Reduction of amenities: XXX

7. SHIPPING INFORMATION

- 7.1 Grades of Purity: Industrial pure = 99-%; Thiophene-free = 99-%; Nitrogen = 99-%; Industrial = 90% - 95-%; Reagent = 99-%
- 7.2 Storage Temperature: Ambient
- 7.3 Inert Atmosphere: No requirement
- 7.4 Venting: Pressure-vacuum
- 7.5 IMDG Pollution Category: C
- 7.6 Ship Type: J
- 7.7 Barge Hull Type: J

8. HAZARD CLASSIFICATIONS

- 8.1 49 CFR Category: Flammable liquid
- 8.2 49 CFR Class: 3
- 8.3 49 CFR Package Group: II
- 8.4 Flame Potential: No
- 8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Instability (Yellow)	0
- 8.6 EPA Reportable Quantity: 10 pounds
- 8.7 EPA Pollution Category: A
- 8.8 RCRA Waste Number: U019
- 8.9 EPA PWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

- 9.1 Physical State at 15° C and 1 atm: Liquid
- 9.2 Molecular Weight: 78.11
- 9.3 Boiling Point at 1 atm: 179°F = 80.1°C = 353.3°K
- 9.4 Freezing Point: 42.0°F = 5.5°C = 278.7°K
- 9.5 Critical Temperature: 552.0°F = 288.9°C = 342.1°K
- 9.6 Critical Pressure: 710 psia = 48.3 atm = 4.89 MPa
- 9.7 Specific Gravity: 0.879 at 20°C (Wt/Wt)
- 9.8 Liquid Surface Tension: 28.9 dynes/cm = 0.0289 N/m at 20°C
- 9.9 Liquid Water Interfacial Tension: 35.0 dynes/cm = 0.035 N/m at 20°C
- 9.10 Vapor (Gas) Specific Gravity: 2.8
- 9.11 Ratio of Specific Heats of Vapor (Gas): 1.081
- 9.12 Latent Heat of Vaporization: 188 Btu/lb = 94.1 cal/g = 3.94 X 10⁵ J/kg
- 9.13 Heat of Combustion: -17,450 Btu/lb = -9596 cal/g = -406.3 X 10³ J/kg
- 9.14 Heat of Decomposition: Not pertinent.
- 9.15 Heat of Solution: Not pertinent.
- 9.16 Heat of Polymerization: Not pertinent.
- 9.17 Heat of Fusion: 30.45 cal/g
- 9.18 Limiting Value: Currently not available
- 9.19 Reid Vapor Pressure: 3.22 psia

NOTES

BENZENE

BNZ

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
55	53.330	45	0.394	75	0.388	55	0.724
60	53.140	50	0.398	80	0.381	60	0.692
65	54.980	55	0.399	85	0.375	65	0.665
70	54.770	60	0.400	90	0.369	70	0.638
75	54.580	65	0.402	95	0.362	75	0.612
80	54.400	70	0.405	100	0.356	80	0.588
85	54.210	75	0.407	105	0.350	85	0.566
90	54.020	80	0.409	110	0.344	90	0.544
95	53.840	85	0.411	115	0.337	95	0.524
100	53.660	90	0.414	120	0.331	100	0.505
105	53.470	95	0.416	125	0.325	105	0.487
110	53.290	100	0.418	130	0.319	110	0.470
115	53.100			135	0.312	115	0.453
120	52.920			140	0.306	120	0.438
125	52.730			145	0.300		
130	52.540			150	0.293		
135	52.348			155	0.287		
140	52.170			160	0.281		
145	51.990			165	0.275		
150	51.808			170	0.268		
155	51.620						
160	51.430						
165	51.250						
170	51.060						
175	50.870						

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
77	0.180	50	0.281	50	0.01258	0	0.284
		60	1.171	60	0.01639	25	0.219
		70	1.333	70	0.02109	50	0.234
		80	1.989	80	0.02681	75	0.248
		90	2.547	90	0.03271	100	0.261
		100	3.227	100	0.04194	125	0.275
		110	4.049	110	0.05172	150	0.288
		120	5.033	120	0.06217	175	0.295
		130	6.291	130	0.07652	200	0.313
		140	7.377	140	0.09194	225	0.325
		150	9.187	150	0.10980	250	0.337
		160	11.040	160	0.12980	275	0.349
		170	13.226	170	0.15270	300	0.360
		180	15.708	180	0.17850	325	0.371
		190	18.320	190	0.20750	350	0.381
		200	21.748	200	0.23970	375	0.392
		210	25.360	210	0.27580	400	0.402
						425	0.412
						450	0.421
						475	0.431
						500	0.440
						525	0.449
						550	0.457
						575	0.465
						600	0.474

ETHYLBENZENE

ETB

Common Synonyms Phenylmethane EB	Liquid Colorless Sweet, gasoline-like odor Floats on water. Flammable, irritating vapor is produced.
<p>Avoid contact with liquid and vapor. Keep people away. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Shut off ignition sources and call fire department. Stop discharge if possible. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
Fire	<p>FLAMMABLE Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>
Exposure	<p>CALL FOR MEDICAL AID.</p> <p>VAPOR Irritating to eyes, nose and throat. If inhaled, will cause dizziness or difficult breathing. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>LIQUID Will burn skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>
Water Pollution	<p>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. Floating to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Mechanical containment Should be removed Chemical and physical treatment</p>	<p>2. LABEL 2.1 Category: Flammable Liquid 2.2 Class: 3</p>
<p>3. CHEMICAL DESIGNATIONS 3.1 CO Compatibility Class: Aromatic hydrocarbon 3.2 Formula: C_8H_{10} 3.3 HPG/UN Designations: 3.3/1173 3.4 DOT ID No.: 1173 3.5 CAS Registry No.: 100-41-4</p>	<p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Aromatic</p>
<p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Self-contained breathing apparatus; safety goggles. 5.2 Symptoms Following Exposure: Inhalation may cause irritation of nose, dizziness, depression. Moderate irritation of eye with corneal injury possible. Irritates skin and may cause blisters. 5.3 Treatment of Exposure: INHALATION: If ill effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly; if breathing stops, give artificial respiration. INGESTION: induce vomiting only upon physician's approval; material in lung may cause chemical pneumonia. SKIN AND EYES: promptly flush with plenty of water (15 min. for eyes) and get medical attention; remove and wash contaminated clothing before reuse. 5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limit: 200 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 2; LD₅₀ = 0.5 to 1 g/kg (rat) 5.7 Lethal Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Causes smothering of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure. 5.10 Odor Threshold: 140 ppm 5.11 IDLH Value: 2,000 ppm</p>	

<p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: 90°F O.C.; 50°F C.C. 6.2 Flammable Limits in Air: 1.0%-6.7% 6.3 Fire Extinguishing Agents: Foam (most effective), water fog, carbon dioxide or dry chemical. 6.4 Fire Extinguishing Agents: Not to be Used: Not pertinent 6.5 Special Hazards of Combustion: Products: Irritating vapors are generated when heated. 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to the source of ignition and flash back. 6.7 Ignition Temperature: 560°F 6.8 Electrical Hazards: Not pertinent 6.9 Burning Rate: 5.8 mm/min. 6.10 Accelerated Flame Temperature: Data Not Available</p> <p>(Continued)</p>	<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U</p>
<p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity With Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data Not Available 7.8 Reactivity Group: 32</p>	<p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation: Category: _____ Rating: _____ Fire: _____ 3 Health: _____ Vapor Irritant: _____ 2 Liquid or Solid Irritant: _____ 2 Poison: _____ 2 Water Pollution: _____ Human Toxicity: _____ 1 Aquatic Toxicity: _____ 3 Aesthetic Effect: _____ 2 Reactivity: _____ Other Chemicals: _____ 1 Water: _____ 0 Self Reaction: _____ 0</p> <p>11.3 NFPA Hazard Classifications: Category: _____ Classification: _____ Health Hazard (Blue): _____ 2 Flammability (Red): _____ 3 Reactivity (Yellow): _____ 0</p>
<p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 28 ppm/96 hr/bowfin/TL₅₀/fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 2.8% (theor.), 3 days 8.4 Food Chain Concentration Potential: None</p>	<p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 106.17 12.3 Boiling Point at 1 atm: 77.2°F = 136.2°C = 409.4°K 12.4 Freezing Point: -128°F = -95°C = 178°K 12.5 Critical Temperature: 351.0°F = 143.9°C = 617.1°K 12.6 Critical Pressure: 523 psia = 35.6 atm = 3.61 MN/m² 12.7 Specific Gravity: 0.867 at 20°C (liquid) 12.8 Liquid Surface Tension: 29.2 dynes/cm = 0.0292 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 35.48 dynes/cm = 0.03548 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.071 12.12 Latent Heat of Vaporization: 144 Btu/lb = 80.1 cal/g = 3.29 X 10⁴ J/kg 12.13 Heat of Combustion: -17,780 Btu/lb = -8677 cal/g = -13.5 X 10⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.17 Heat of Fusion: Data Not Available 12.18 Limiting Values: Data Not Available 12.19 Viscosity: 0.4 cP</p>
<p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Research grade: 99.98%; pure grade: 99.5%; technical grade: 98.0% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (Bottle arrester) or pressure-relieving</p>	<p>6. FIRE HAZARDS (Continued)</p> <p>6.11 Stoichiometric Air to Fuel Ratio: Data Not Available 6.12 Flame Temperature: Data Not Available</p>

ETHYLBENZENE

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
	54.990	40	.402	-90	1.065	40	.835
	54.580	50	.404	-80	1.056	50	.774
	54.370	60	.407	-70	1.047	60	.719
	54.060	70	.409	-60	1.037	70	.670
	53.750	80	.412	-50	1.028	80	.626
	53.430	90	.414	-40	1.018	90	.586
	53.120	100	.417	-30	1.009	100	.550
	52.810	110	.419	-20	1.000	110	.518
	52.500	120	.421	-10	.990	120	.488
	52.190	130	.424	0	.981	130	.461
	51.870	140	.426	10	.971	140	.436
	51.560	150	.429	20	.962	150	.414
	51.250	160	.431	30	.953	160	.393
	50.940	170	.434	40	.943	170	.374
	50.620	180	.436	50	.934	180	.356
	50.310	190	.439	60	.924	190	.340
	50.000	200	.441	70	.915	200	.325
	49.690	210	.443	80	.906	210	.311
				90	.896		
				100	.887		
				110	.877		
				120	.868		
				130	.859		
				140	.849		
				150	.840		
				160	.830		

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
3.02	.020	80	.202	80	.00370	-400	-.007
		100	.370	100	.00654	-350	.026
		120	.644	120	.01099	-300	.060
		140	1.071	140	.01767	-250	.093
		160	1.713	160	.02734	-200	.125
		180	2.643	180	.04087	-150	.157
		200	3.953	200	.05926	-100	.187
		220	5.747	220	.08363	-50	.217
		240	8.147	240	.11520	0	.246
		260	11.290	260	.15510	50	.274
		280	15.320	280	.20490	100	.301
		300	20.410	300	.26570	150	.327
		320	26.730	320	.33910	200	.353
		340	34.460	340	.42620	250	.377
		360	43.800	360	.52850	300	.401
		380	54.950	380	.64720	350	.424
						400	.446
						450	.467
						500	.487
						550	.507
						600	.525

HYDROFLUORIC ACID

HFA

CAUTIONARY RESPONSE INFORMATION

Common Synonyms	Watery liquid	Colorless to green	Irritating odor
Sinks and mixes with water. Harmful vapor is produced.			
<p>Evaluate.</p> <p>Keep people away. AVOID CONTACT WITH LIQUID AND VAPOR.</p> <p>Wear chemical protective suit with self-contained breathing apparatus.</p> <p>Stay upwind and use water spray to "knock down" vapor.</p> <p>Notify local health and pollution control agencies.</p> <p>Protect water intakes.</p>			
Fire	<p>Not flammable.</p> <p>Flammable gas may be produced on contact with metals.</p> <p>Wear chemical protective suit with self-contained breathing apparatus.</p>		
Exposure	<p>CALL FOR MEDICAL AID.</p> <p>VAPOR</p> <p>Will burn eyes, nose and throat.</p> <p>Harmful if inhaled.</p> <p>Move to fresh air.</p> <p>If breathing has stopped, give artificial respiration.</p> <p>If breathing is difficult, give oxygen.</p> <p>IF IN EYES, hold eyelids open and flush with plenty of water.</p> <p>LIQUID</p> <p>Will burn skin and eyes.</p> <p>Harmful if swallowed.</p> <p>Remove contaminated clothing and shoes.</p> <p>Flush affected areas with plenty of water.</p> <p>IF IN EYES, hold eyelids open and flush with plenty of water.</p> <p>IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.</p> <p>DO NOT INDUCE VOMITING.</p>		
Water Pollution	<p>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.</p> <p>May be dangerous if it enters water intakes.</p> <p>Notify local health and wildlife officials.</p> <p>Notify operators of nearby water intakes.</p>		

1. CORRECTIVE RESPONSE ACTIONS

DNM and disperse
 Stop discharge
 Chemical and Physical Treatment:
 Neutralize

2. CHEMICAL DESIGNATIONS

- 2.1 CG Compatibility Group: 1; Non-oxidizing mineral acid
- 2.2 Formula: HF-H₂O
- 2.3 IMOUM Designation: 8.0/1790
- 2.4 DOT ID No.: 1790
- 2.5 CAS Registry No.: 7564-39-3
- 2.6 NAERG Guide No.: 157
- 2.7 Standard Industrial Trade Classification: 52235

3. HEALTH HAZARDS

- 3.1 Personal Protective Equipment: Proper protective clothing must be worn that encapsulates the body including the face. All persons handling this product must be familiar with and must observe all the precautions contained in the Manufacturing Chemists' Association Chemical Safety Data Sheet SD-25. A shower and an eye wash must be available.
- 3.2 Symptoms Following Exposure: Serious and painful burns of eyes and skin.
- 3.3 Treatment of Exposure: **INGESTION:** have victim drink water or milk; do NOT induce vomiting. **SKIN:** if victim has come in contact with liquid or vapor, put him in a shower and call a physician. **EYES:** flush with water for at least 15 min. and consult physician.
- 3.4 TLV-TWA: Not listed.
- 3.5 TLV-STEL: Not listed.
- 3.6 TLV-Ceiling: 3 ppm as F
- 3.7 Toxicity by Ingestion: Currently not available.
- 3.8 Toxicity by Inhalation: Currently not available.
- 3.9 Chronic Toxicity: Currently not available.
- 3.10 Vapor (Gas) Irritant Characteristics: Vapors cause severe irritation of eye and throat and can cause eye and lung injury. They cannot be tolerated even at low concentrations.
- 3.11 Liquid or Solid Characteristics: Severe skin irritant. Causes second and third-degree burns on short contact; very injurious to the eyes.
- 3.12 Odor Threshold: Currently not available.
- 3.13 IDLH Value: 30 ppm as F
- 3.14 OSHA PEL-TWA: 3 ppm as F
- 3.15 OSHA PEL-STEL: Not listed.
- 3.16 OSHA PEL-Ceiling: Not listed.
- 3.17 EPA AEGL: Not listed.

4. FIRE HAZARDS

- 4.1 Flash Point: Not flammable
- 4.2 Flammable Limits in Air: Not flammable
- 4.3 Fire Extinguishing Agents: Not pertinent
- 4.4 Fire Extinguishing Agents Not to Be Used: Not pertinent
- 4.5 Special Hazards of Combustion Products: Toxic and irritating vapors are generated when heated.
- 4.6 Behavior in Fire: Not pertinent
- 4.7 Auto Ignition Temperature: Not flammable
- 4.8 Electrical Hazards: Not pertinent
- 4.9 Burning Rate: Not flammable
- 4.10 Adiabatic Flame Temperature: Currently not available
- 4.11 Stoichiometric Air to Fuel Ratio: Not pertinent
- 4.12 Flame Temperature: Currently not available
- 4.13 Combustion Molar Ratio (Reactant to Product): Not pertinent
- 4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

- 5.1 Reactivity with Water: No reaction
- 5.2 Reactivity with Common Materials: Will attack glass, concrete and certain metals containing silica, such as cast iron. Will attack natural rubber, leather, and many organic materials. May generate flammable hydrogen in contact with some metals.
- 5.3 Stability During Transport: Stable
- 5.4 Neutralizing Agents for Acids and Caustics: Flush with water; apply powdered limestone, slaked lime, soda ash, or sodium bicarbonate.
- 5.5 Polymerization: Not pertinent
- 5.6 Inhibitor of Polymerization: Not pertinent

7. SHIPPING INFORMATION

- 7.1 Grades of Purity: Reagent: 48-51%; Technical: 52-55%; 70% grade
- 7.2 Storage Temperature: Ambient
- 7.3 Inert Atmosphere: No requirement
- 7.4 Venting: Pressure-vacuum
- 7.5 IMO Pollution Category: B
- 7.6 Ship Type: Data not available
- 7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

- 8.1 49 CFR Category: Corrosive material
- 8.2 49 CFR Class: 8
- 8.3 49 CFR Package Group: I
- 8.4 Marine Pollutant: No
- 8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	4
Flammability (Red)	0
Instability (Yellow)	0
- 8.6 EPA Reportable Quantity: 100 pounds
- 8.7 EPA Pollution Category: B
- 8.8 RCRA Waste Number: U134
- 8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

- 9.1 Physical State at 15° C and 1 atm: Liquid
- 9.2 Molecular Weight: Not pertinent
- 9.3 Boiling Point at 1 atm: 152°F = 67°C = 340°K
- 9.4 Freezing Point: Not pertinent
- 9.5 Critical Temperature: Not pertinent
- 9.6 Critical Pressure: Not pertinent
- 9.7 Specific Gravity: 1.258 at 25°C (liquid)
- 9.8 Liquid Surface Tension: Not pertinent
- 9.9 Liquid Water Interfacial Tension: Not pertinent
- 9.10 Vapor (Gas) Specific Gravity: Not pertinent
- 9.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
- 9.12 Latent Heat of Vaporization: 649 Btu/lb = 361 cal/g = 15.1 X 10³ J/kg
- 9.13 Heat of Combustion: Not pertinent
- 9.14 Heat of Decomposition: Not pertinent
- 9.15 Heat of Solution: -66.6 Btu/lb = -37.0 cal/g = -1.55 X 10³ J/kg
- 9.16 Heat of Polymerization: Not pertinent
- 9.17 Heat of Fusion: 54.7 cal/g
- 9.18 Limiting Value: Currently not available
- 9.19 Reid Vapor Pressure: Varies *Physical properties apply to 70% of solution.

NOTES

HYDROFLUORIC ACID

HFA

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
15	80.429	34	0.702		N O T P E R T I N E N T	32	0.850
20	80.280	36	0.704				
25	80.120	38	0.707				
30	79.959	40	0.709				
35	79.809	42	0.711				
40	79.650	44	0.713				
45	79.490	46	0.715				
50	79.339	48	0.718				
55	79.179	50	0.720				
60	79.030	52	0.722				
65	78.870	54	0.724				
70	78.708	56	0.727				
75	78.558	58	0.729				
80	78.400	60	0.731				
85	78.250	62	0.733				
		64	0.735				
		66	0.738				
		68	0.740				
		70	0.742				
		72	0.744				
		74	0.747				
		76	0.749				
		78	0.751				
		80	0.753				
		82	0.755				
		84	0.758				

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	M I S C I B L E		C U R R E N T L Y N O T A V A I L A B L E		C U R R E N T L Y N O T A V A I L A B L E		N O T P E R T I N E N T

HYDROGEN SULFIDE

HDS

CAUTIONARY RESPONSE INFORMATION

Common Synonyms Sulfuretted hydrogen Sulphuretted hydrogen	Gas	Cobwebs	Rotten egg odor, but odorless at poisonous concentrations
Sinks and boils in water. Poisonous, flammable, visible vapor cloud is produced.			
Keep people away. Avoid contact with gas. Wear goggles and self-contained breathing apparatus. Shut off ignition sources and call fire department. Evacuate area in case of large discharges. Stay upwind and use water spray to "knock down" vapor. Notify local health and pollution control agencies. Protect water intakes.			
Fire	FLAMMABLE. Flashback along vapor trail may occur. May explode if ignited in an enclosed area. Wear goggles and self-contained breathing apparatus. Stop flow of gas if possible. Cool exposed containers and men effecting shut-off with water. Let fire burn.		
Exposure	CALL FOR MEDICAL AID. VAPOR POISONOUS IF INHALED. Irritating to eyes. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. IF IN EYES, hold eyelids open and flush with plenty of water.		
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		

1. CORRECTIVE RESPONSE ACTIONS

Dilute and disperse
Stop discharge

2. CHEMICAL DESIGNATIONS

- 2.1 CG Compatibility Group: Not listed.
- 2.2 Formula: H₂S
- 2.3 IMO/UN Designation: 2.D/1053
- 2.4 DOT ID No.: 1053
- 2.5 CAS Registry No.: 7783-06-4
- 2.6 NAERG Guide No.: 117
- 2.7 Standard Industrial Trade Classification: 52242

3. HEALTH HAZARDS

- 3.1 Personal Protective Equipment: Rubber-faced goggles; approved respiratory protection.
- 3.2 Symptoms Following Exposure: Irritation of eyes, nose and throat. If high concentrations are inhaled, hyperventilation and respiratory paralysis may occur. Very high concentrations may produce pulmonary edema.
- 3.3 Treatment of Exposure: **INHALATION:** remove victim from exposure; if breathing has stopped, give artificial respiration; administer oxygen if needed; consult physician. **EYES:** wash with plenty of water.
- 3.4 TLV-TWA: 10 ppm
- 3.5 TLV-STEL: Not listed.
- 3.6 TLV-Ceiling: 15 ppm
- 3.7 Toxicity by Ingestion: Hydrogen sulfide is present as a gas at room temperature, so ingestion not likely.
- 3.8 Toxicity by Inhalation: Currently not available.
- 3.9 Chronic Toxicity: Currently not available.
- 3.10 Vapor (Gas) Irritant Characteristics: Vapor is moderately irritating such that personnel will not usually tolerate moderate or high vapor concentrations.
- 3.11 Liquid or Solid Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smothering and reddening of the skin.
- 3.12 Odor Threshold: 0.0047 ppm
- 3.13 IDLH Value: 100 ppm
- 3.14 OSHA PEL-TWA: Not listed.
- 3.15 OSHA PEL-STEL: 50 ppm, 10 minute peak once per 8 hour shift.
- 3.16 OSHA PEL-Ceiling: 20 ppm
- 3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

- 4.1 Flash Point: Flammable gas
- 4.2 Flammable Limits in Air: 4.3%-45%
- 4.3 Fire Extinguishing Agents: Stop flow of gas
- 4.4 Fire Extinguishing Agents Not to Be Used: Not pertinent
- 4.5 Special Hazards of Combustion Products: Toxic gases are generated in fires.
- 4.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
- 4.7 Auto Ignition Temperature: 500°F
- 4.8 Electrical Hazards: Not pertinent
- 4.9 Burning Rate: 2.3 mm/min (liquid)
- 4.10 Adiabatic Flame Temperature: Currently not available
- 4.11 Stoichiometric Air to Fuel Ratio: 7.1 (calc.)
- 4.12 Flame Temperature: Currently not available
- 4.13 Combustion Molar Ratio (Reactant to Product): 2.0 (calc.)
- 4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed; 7.5%; CO₂ diluent: 11.5%

5. CHEMICAL REACTIVITY

- 5.1 Reactivity with Water: No reaction
- 5.2 Reactivity with Common Materials: No reaction
- 5.3 Stability During Transport: Stable
- 5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
- 5.5 Polymerization: Not pertinent
- 5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

- 6.1 Aquatic Toxicity: 1-38 ppm/48 hr to head minnows/TL₅₀/fresh water sat./0.5 hr to 80% lethality/salt water
- 6.2 Waterfowl Toxicity: Currently not available
- 6.3 Biological Oxygen Demand (BOD): Currently not available
- 6.4 Food Chain Concentration Potential: None
- 6.5 GESAMP Hazard Profile: Bioaccumulation: 0
Damage to living resources: 3
Human Oral hazard: 2
Human Contact hazard: II
Reduction of amenities: XX

7. SHIPPING INFORMATION

- 7.1 Grades of Purity: Purified; technical
- 7.2 Storage Temperature: Ambient
- 7.3 Inert Atmosphere: No requirement
- 7.4 Venting: Safety relief
- 7.5 IMO Pollution Category: Currently not available
- 7.6 Ship Type: Currently not available
- 7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

- 8.1 48 CFR Category: Poison gas
- 8.2 49 CFR Class: 2.3
- 8.3 49 CFR Package Group: Not pertinent
- 8.4 Marine Pollutant: No
- 8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	4
Instability (Yellow)	0
- 8.6 EPA Reportable Quantity: 100 pounds
- 8.7 EPA Pollution Category: B
- 8.8 RCRA Waste Number: U135
- 8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

- 9.1 Physical State at 15° C and 1 atm: Gas
- 9.2 Molecular Weight: 34.08
- 9.3 Boiling Point at 1 atm: -76.7°F = -60.4°C = 212.8°K
- 9.4 Freezing Point: -117°F = -82.8°C = 190.4°K
- 9.5 Critical Temperature: 212.7°F = 100.4°C = 373.8°K
- 9.6 Critical Pressure: 1300 psia = 88.9 atm = 9.01 MN/m²
- 9.7 Specific Gravity: 0.916 at -60°C (liquid)
- 9.8 Liquid Surface Tension: (est.) 30 dynes/cm = 0.03 N/m at -61°C
- 9.9 Liquid Water Interfacial Tension: Currently not available
- 9.10 Vapor (Gas) Specific Gravity: 1.2
- 9.11 Ratio of Specific Heats of Vapor (Gas): 1.322
- 9.12 Latent Heat of Vaporization: 234 Btu/lb = 130 cal/g = 5.44 x 10⁵ J/kg
- 9.13 Heat of Combustion: -6552 Btu/lb = -3640 cal/g = -152.4 x 10³ J/kg
- 9.14 Heat of Decomposition: Not pertinent
- 9.15 Heat of Solution: Not pertinent
- 9.16 Heat of Polymerization: Not pertinent
- 9.17 Heat of Fusion: 16.8 cal/g
- 9.18 Limiting Value: Currently not available
- 9.19 Reid Vapor Pressure: Currently not available

NOTES

HYDROGEN SULFIDE

HDS

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
N O T		-36	0.430	N O T		-111	0.510
P E R T I M E N T		-32	0.430				
		-30	0.430				
		-28	0.430				
		-24	0.430				
		-22	0.430				
		-20	0.430				
		-18	0.430				

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
N O T		-40	13.210	-40	0.11090	0	0.316
P E R T I M E N T		-76	17.400	-76	0.14472	25	0.317
		-45	19.810	-45	0.15950	75	0.328
		-50	22.520	-40	0.17890	100	0.341
		-50	28.780	-50	0.20090	175	0.342
		-45	32.990	-45	0.21400	1150	0.344
		-40	36.500	-40	0.22710	2000	0.346
		-35	40.700	-35	0.24320	3235	0.348
		-30	46.000	-30	0.25870	3500	0.349
		-25	50.600	-25	0.27510	3500	0.351
		-20	54.210	-20	0.29290	3500	0.354
		-18	62.290	-18	0.31160	3500	0.354
		-15	70.000	-15	0.33160	3500	0.354
		-10	78.680	-10	0.35300	3500	0.357
		0	83.680	0	0.37500	3500	0.358
		5	91.519	5	0.39700	4950	0.362
		10	100.799	10	0.42000	4950	0.365
		15	110.290	15	0.44480	5000	0.368
		25	131.290	25	0.51920	5500	0.377
		30	143.200	30	0.59880	5775	0.387
		35	155.290	35	0.68680	6000	0.397
		40	168.000	40	0.78000		0.407
		45	182.000	45	0.88000		0.417

METHANE

MTH

CAUTIONARY RESPONSE INFORMATION

Common Synonyms	Gas	Colorless	Weak odor
Marsh gas Natural gas	Liquid floats and boils on water. Flammable visible vapor cloud is produced.		
Keep people away. Avoid inhalation. Shut off ignition sources and call fire department. Stay upwind and use water spray to "knock down" vapor. Evacuate area in case of large discharge. Avoid contact with liquid and vapor. Notify local health and pollution control agencies.			
Fire	FLAMMABLE. Flashback along vapor trail may occur. May explode if ignited in an enclosed area. Stop discharge if possible. Cool exposed containers and protect men effecting shutoff with water. Let fire burn.		
Exposure	CALL FOR MEDICAL AID. VAPOR Not irritating to eyes, nose or throat. If inhaled, will cause dizziness, difficult breathing, and loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Will cause frostbite. Flush affected areas with plenty of water. DO NOT RUB AFFECTED AREAS		
Water Pollution	Not harmful to aquatic life.		

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Chemical and Physical Treatment: Burn

2. CHEMICAL DESIGNATIONS

- 2.1 CG Compatibility Group: 31; Paraffin
- 2.2 Formula: CH₄
- 2.3 IMO/JUN Designation: 2.0/1971
- 2.4 DOT ID No.: 1971
- 2.5 CAS Registry No.: 74-82-8
- 2.6 NAERG Guide No.: 115
- 2.7 Standard Industrial Trade Classification: 51114

3. HEALTH HAZARDS

- 3.1 Personal Protective Equipment: Self-contained breathing apparatus for high concentrations; protective clothing if exposed to liquid.
- 3.2 Symptoms Following Exposure: High concentrations may cause asphyxiation. No systemic effects, even at 5% concentration in air.
- 3.3 Treatment of Exposure: Remove to fresh air. Support respiration.
- 3.4 TLV-TWA: Not listed.
- 3.5 TLV-STEL: Not listed.
- 3.6 TLV-Ceiling: Not listed.
- 3.7 Toxicity by Ingestion: Not pertinent.
- 3.8 Toxicity by Inhalation: Currently not available.
- 3.9 Chronic Toxicity: None.
- 3.10 Vapor (Gas) Irritant Characteristics: Vapors are nonirritating to the eyes and throat.
- 3.11 Liquid or Solid Characteristics: No appreciable hazard. Practically harmless to the skin, because it evaporates quickly, but may cause some frostbite.
- 3.12 Odor Threshold: 200 ppm
- 3.13 IDLH Value: Not listed.
- 3.14 OSHA PEL-TWA: Not listed.
- 3.15 OSHA PEL-STEL: Not listed.
- 3.16 OSHA PEL-Ceiling: Not listed.
- 3.17 EPA AEGL: Not listed.

4. FIRE HAZARDS

- 4.1 Flash Point: Flammable gas
- 4.2 Flammable Limits in Air: 5.0%-15.0%
- 4.3 Fire Extinguishing Agents: Stop flow of gas
- 4.4 Fire Extinguishing Agents Not to Be Used: Water
- 4.5 Special Hazards of Combustion Products: None
- 4.6 Behavior in Fire: Not pertinent
- 4.7 Auto Ignition Temperature: 1004°F
- 4.8 Electrical Hazards: Class I, Group D
- 4.9 Burning Rate: 12.5 mm/min.
- 4.10 Adiabatic Flame Temperature: 2339. (Est.)
- 4.11 Stoichiometric Air to Fuel Ratio: 9.5 (calc.)
- 4.12 Flame Temperature: Currently not available
- 4.13 Combustion Molar Ratio (Reactant to Product): 3.0 (calc.)
- 4.14 Minimum Oxygen Concentration for Combustion (MOCC): No diluent: 12.0-12.1%; CO₂ diluent: 14.0-14.5%

5. CHEMICAL REACTIVITY

- 5.1 Reactivity with Water: No reaction
- 5.2 Reactivity with Common Materials: No reaction
- 5.3 Stability During Transport: Stable
- 5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
- 5.5 Polymerization: Not pertinent
- 5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

- 6.1 Aquatic Toxicity: None
- 6.2 Waterfowl Toxicity: None
- 6.3 Biological Oxygen Demand (BOD): None
- 6.4 Food Chain Concentration Potential: None
- 6.5 GESAMP Hazard Profile: Not listed

7. SHIPPING INFORMATION

- 7.1 Grades of Purity: Research grade, pure grade
- 7.2 Storage Temperature: -260°F
- 7.3 Inert Atmosphere: No requirement
- 7.4 Venting: Safety relief
- 7.5 IMO Pollution Category: Currently not available
- 7.6 Ship Type: 2
- 7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

- 8.1 49 CFR Category: Flammable gas
- 8.2 49 CFR Class: 2.1
- 8.3 49 CFR Package Group: Not pertinent.
- 8.4 Marine Pollutant: No
- 8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue).....	1
Flammability (Red).....	4
Instability (Yellow).....	0
- 8.6 EPA Reportable Quantity: Not listed.
- 8.7 EPA Pollution Category: Not listed.
- 8.8 RCRA Waste Number: Not listed
- 8.9 EPA FWPCA List: Not listed

9. PHYSICAL & CHEMICAL PROPERTIES

- 9.1 Physical State at 15° C and 1 atm: Gas
- 9.2 Molecular Weight: 16.04
- 9.3 Boiling Point at 1 atm: -258.7°F = -161.5°C = 111.7°K
- 9.4 Freezing Point: -296.5°F = -182.5°C = 90.7°K
- 9.5 Critical Temperature: -116.5°F = -82.5°C = 190.7°K
- 9.6 Critical Pressure: 668 psia = 45.44 atm = 4.60 MPa/m²
- 9.7 Specific Gravity: 0.422 at -160°C (liquid)
- 9.8 Liquid Surface Tension: 14 dynes/cm = 0.014 N/m at -161°C
- 9.9 Liquid Water Interfacial Tension: (est.) 50 dynes/cm = 0.050 N/m at -161°C
- 9.10 Vapor (Gas) Specific Gravity: 0.55 1.0
- 9.11 Ratio of Specific Heats of Vapor (Gas): 1.306
- 9.12 Latent Heat of Vaporization: 219.4 Btu/lb = 121.9 cal/g = 5.100 X 10⁵ J/kg
- 9.13 Heat of Combustion: -21,517 Btu/lb = -11,954 cal/g = -500.2 X 10³ J/kg
- 9.14 Heat of Decomposition: Not pertinent
- 9.15 Heat of Solution: Not pertinent
- 9.16 Heat of Polymerization: Not pertinent
- 9.17 Heat of Fusion: 13.96 cal/g
- 9.18 Limiting Value: Currently not available
- 9.19 Reid Vapor Pressure: Very high

NOTES

METHANE

MTH

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
-290	27.990	-290	0.802		N	-290	0.290
-288	27.900	-285	0.806		O	-285	0.254
-286	27.800	-280	0.815		T	-280	0.225
-284	27.700	-275	0.821			-275	0.200
-282	27.610	-270	0.827		P	-270	0.179
-280	27.510	-265	0.833		E	-265	0.161
-278	27.410	-260	0.839		R	-260	0.146
-276	27.310				T		
-274	27.220				I		
-272	27.120				N		
-270	27.020				E		
-268	26.930				N		
-266	26.830				T		
-264	26.730						
-262	26.630						
-260	26.540						

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	-290	2.640	-290	0.02325	0	0.504
	N	-288	3.005	-288	0.02617	25	0.513
	S	-286	3.412	-286	0.02936	50	0.522
	O	-284	3.861	-284	0.03284	75	0.532
	L	-282	4.355	-282	0.03663	100	0.541
	U	-280	4.898	-280	0.04074	125	0.551
	B	-278	5.494	-278	0.04519	150	0.561
	L	-276	6.146	-276	0.05000	175	0.572
	E	-274	6.858	-274	0.05519	200	0.582
		-272	7.633	-272	0.06077	225	0.593
		-270	8.474	-270	0.06676	250	0.604
		-268	9.387	-268	0.07318	275	0.615
		-266	10.370	-266	0.08004	300	0.626
		-264	11.440	-264	0.08736	325	0.638
		-262	12.590	-262	0.09516	350	0.650
		-260	13.820	-260	0.10350	375	0.662
		-258	15.130	-258	0.11230	400	0.674
		-256	16.570	-256	0.12160	425	0.686
		-254	18.100	-254	0.13150	450	0.699
		-252	19.720	-252	0.14190	475	0.712
		-250	21.460	-250	0.15290	500	0.724
		-248	23.310	-248	0.16450	525	0.738
		-246	25.270	-246	0.17670	550	0.751
		-244	27.360	-244	0.18960	575	0.765
		-242	29.580	-242	0.20300	600	0.778
		-240	31.920	-240	0.21710		

METHYL TERT-BUTYL ETHER

MBE

CAUTIONARY RESPONSE INFORMATION

Common Synonyms tert-Butyl methyl ether 2-Methoxy-2-methyl propane 2-Methyl-2-methoxy propane		Liquid	Colorless
		Floats and mixes slowly with water.	
Keep people away. Avoid contact with liquid and vapor. Wear goggles and self-contained breathing apparatus. Shut off ignition sources and call fire department. Stay upwind and use water spray to "knock down" vapors. Notify local health and pollution control agencies.			
Fire	FLAMMABLE Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles, self-contained breathing apparatus, and rubber over-clothing, including gloves and boots. Extinguish with water spray, dry chemical, foam or carbon dioxide. Cool exposed containers with water.		
Exposure	CALL FOR MEDICAL AID. VAPOR A mild irritant to eyes and skin. If inhaled, may cause dizziness and/or suffocation. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID May irritate or burn skin and eyes. May be harmful if swallowed. IF IN EYES OR ON SKIN: flush with running water for at least 15 minutes; hold eyelids open if necessary. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.		
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Skim
Chemical and Physical Treatment: Burn

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: 41; Ether
2.2 Formula: $(CH_3)_3COCH_2CH_3$
2.3 IMO/UN Designation: 3/2398
2.4 DOT ID No.: 2398
2.5 CAS Registry No.: Currently not available
2.6 NAERG Guide No.: 127
2.7 Standard Industrial Trade Classification: 51616

3. HEALTH HAZARDS

- 3.1 Personal Protective Equipment: Wear goggles, self-contained breathing apparatus, rubber gloves, boots and overclothing.
- 3.2 Symptoms Following Exposure: **INHALATION:** May cause dizziness or suffocation. Contact may irritate or burn eyes or skin. May be harmful if swallowed.
- 3.3 Treatment of Exposure: **INHALATION:** Move victim to fresh air; call emergency medical care. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. **EYES OR SKIN:** Flush with running water for at least 15 minutes; hold eyelids open if necessary. Remove and isolate contaminated clothing and shoes at the site. Keep victim quiet and maintain normal body temperature. **INGESTION:** If victim is unconscious or having convulsions, do nothing except keep victim warm.
- 3.4 TLV-TWA: 40 ppm
- 3.5 TLV-STEL: Not listed.
- 3.6 TLV-Ceiling: Not listed.
- 3.7 Toxicity by Ingestion: Grade 2; LD₅₀ = 2.96 g/kg (rat)
- 3.8 Toxicity by Inhalation: Currently not available.
- 3.9 Chronic Toxicity: Currently not available.
- 3.10 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes skin and respiratory system if present in high concentrations. The effect is temporary.
- 3.11 Liquid or Solid Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin.
- 3.12 Odor Threshold: Currently not available.
- 3.13 IDLH Value: Not listed.
- 3.14 OSHA PEL-TWA: Not listed.
- 3.15 OSHA PEL-STEL: Not listed.
- 3.16 OSHA PEL-Ceiling: Not listed.
- 3.17 EPA AEGL: Not listed.

4. FIRE HAZARDS

- 4.1 Flash Point: -14°F C.C.
- 4.2 Flammable Limits in Air: Currently not available.
- 4.3 Fire Extinguishing Agents: Water spray, dry chemical, alcohol foam or carbon dioxide.
- 4.4 Fire Extinguishing Agents Not to Be Used: Not pertinent.
- 4.5 Special Hazards of Combustion Products: May contain irritating and toxic gases.
- 4.6 Behavior in Fire: May be ignited by heat, sparks or flames. Containers may explode in heat of fire. Vapor explosion hazard indoors, outdoors, or in sewers.
- 4.7 Auto Ignition Temperature: Currently not available.
- 4.8 Electrical Hazards: Currently not available.
- 4.9 Burning Rate: Currently not available.
- 4.10 Adiabatic Flame Temperature: Currently not available.
- 4.11 Stoichiometric Air to Fuel Ratio: 71.4 (calc.)
- 4.12 Flame Temperature: Currently not available.
- 4.13 Combustion Molar Ratio (Reactant to Product): 22.0 (calc.)
- 4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed.

5. CHEMICAL REACTIVITY

- 5.1 Reactivity with Water: No reaction.
- 5.2 Reactivity with Common Materials: No reaction.
- 5.3 Stability During Transport: May form explosive peroxides on standing. May react vigorously with oxidizing materials.
- 5.4 Neutralizing Agents for Acids and Caustics: Not pertinent.
- 5.5 Polymerization: Not pertinent.
- 5.6 Inhibitor of Polymerization: Not pertinent.

6. WATER POLLUTION

- 6.1 Aquatic Toxicity: Currently not available.
- 6.2 Waterfowl Toxicity: Currently not available.
- 6.3 Biological Oxygen Demand (BOD): Currently not available.
- 6.4 Food Chain Concentration Potential: Currently not available.
- 6.5 GESAMP Hazard Profile:
Bioaccumulation: 0
Damage to living resources: 1
Human Oral hazard: 1
Human Contact hazard: 1
Reduction of amenities: XXX

7. SHIPPING INFORMATION

- 7.1 Grades of Purity: 97%
- 7.2 Storage Temperature: Currently not available.
- 7.3 Inert Atmosphere: Currently not available.
- 7.4 Venting: Currently not available.
- 7.5 IMO Pollution Category: D
- 7.6 Ship Type: Data not available.
- 7.7 Barge Hull Type: Currently not available.

8. HAZARD CLASSIFICATIONS

- 8.1 49 CFR Category: Flammable liquid
- 8.2 49 CFR Class: 3
- 8.3 49 CFR Package Group: II
- 8.4 Marine Pollutant: No
- 8.5 NFPA Hazard Classification: Not listed
- 8.6 EPA Reportable Quantity: 1000 pounds
- 8.7 EPA Pollution Category: C
- 8.8 RCRA Waste Number: Not listed
- 8.9 EPA PWPCA List: Not listed

9. PHYSICAL & CHEMICAL PROPERTIES

- 9.1 Physical State at 15°C and 1 atm: Liquid
- 9.2 Molecular Weight: 88.15
- 9.3 Boiling Point at 1 atm: 131.4°F = 55.2°C = 328.2°K
- 9.4 Freezing Point: -164.2°F = -109°C = 164°K
- 9.5 Critical Temperature: 435.4°F = 224.1°C = 497.3°K
- 9.6 Critical Pressure: 520 psia = 35.4 atm = 3.59 MPa
- 9.7 Specific Gravity: 0.7405 at 20°C
- 9.8 Liquid Surface Tension: Currently not available.
- 9.9 Liquid Water Interfacial Tension: Currently not available.
- 9.10 Vapor (Gas) Specific Gravity: 3.0 (calc.)
- 9.11 Rate of Specific Heats of Vapor (Gas): Currently not available.
- 9.12 Latent Heat of Vaporization: Currently not available.
- 9.13 Heat of Combustion: 16,365 Btu/lb = 9,092 cal/g = 380.7 x 10³ J/kg
- 9.14 Heat of Decomposition: Currently not available.
- 9.15 Heat of Solution: Currently not available.
- 9.16 Heat of Polymerization: Not pertinent.
- 9.17 Heat of Fusion: Data not available.
- 9.18 Limiting Value: Currently not available.
- 9.19 Reid Vapor Pressure: Currently not available.

NOTES

METHYL TERT-BUTYL ETHER

MBE

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
68	45.220		C U R R E N T L Y N O T A V A I L A B L E		C U R R E N T L Y N O T A V A I L A B L E		C U R R E N T L Y N O T A V A I L A B L E

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
77	4.800	-50 -25 0 25 50 75 100 125	0.113 0.101 0.071 0.059 0.051 0.045 0.040 0.036		C U R R E N T L Y N O T A V A I L A B L E		C U R R E N T L Y N O T A V A I L A B L E

NAPHTHALENE

NTM

CAUTIONARY RESPONSE INFORMATION

Common Synonyms	Solid	Odorous	Molecular odor
Naphthalin Tar camphor	Solidifies and floats or sinks in water.		
Keep people away. Avoid inhalation. Call fire department. Avoid contact with liquid and solid. Notify local health and pollution control agencies.			
Fire	Combustible. Wear goggles and self-contained breathing apparatus. Extinguish with water, foam, dry chemical or carbon dioxide. Cool exposed containers with water.		
Exposure	CALL FOR MEDICAL AID. SOLID OR LIQUID Irritating to skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water.		
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. Floating to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
 Containment Systems: Silt Dredge
 Clean shore line
 Salvage waterfowl

2. CHEMICAL DESIGNATIONS

- 2.1 CG Compatibility Group: 32; Aromatic hydrocarbon
- 2.2 Formula: C₁₀H₈
- 2.3 INCIUN Designation: 4.1/2304
- 2.4 DOT ID No.: 1334 (crude/natural); 2304 (isolated)
- 2.5 CAS Registry No.: 91-20-3
- 2.6 NAERG Guide No.: 133
- 2.7 Standard Industrial Trade Classification: 51129

3. HEALTH HAZARDS

- 3.1 Personal Protective Equipment: Approved organic vapor canister unit; rubber gloves; chemical safety goggles; face shield; coveralls and/or rubber apron; rubber shoes or boots.
- 3.2 Symptoms Following Exposure: Vapors or fumes are irritating to eyes, nose, and throat and may cause headaches, dizziness, nausea, etc. Solid may be irritating to skin.
- 3.3 Treatment of Exposure: INHALATION: remove to fresh air. SKIN OR EYES: flush immediately with plenty of water for at least 15 min.; remove contaminated clothing immediately; call a physician.
- 3.4 TLV-TWA: 10 ppm
- 3.5 TLV-STEL: 15 ppm
- 3.6 TLV-Ceiling: Not listed
- 3.7 Toxicity by Ingestion: Grade 2; oral rat LD₅₀ = 1780 mg/kg
- 3.8 Toxicity by Inhalation: Currently not available.
- 3.9 Chronic Toxicity: Currently not available
- 3.10 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
- 3.11 Liquid or Solid Characteristics: Hot liquid can cause severe burn. The solid may irritate the skin.
- 3.12 Odor Threshold: Currently not available
- 3.13 IDLH Value: 250 ppm
- 3.14 OSHA PEL-TWA: 10 ppm
- 3.15 OSHA PEL-STEL: Not listed
- 3.16 OSHA PEL-Ceiling: Not listed
- 3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

- 4.1 Flash Point: 190°F O.C. 174°F C.C.
- 4.2 Flammable Limits in Air: 0.5%-1.9%
- 4.3 Fire Extinguishing Agents: Water fog, carbon dioxide, dry chemical, or foam
- 4.4 Fire Extinguishing Agents Not to Be Used: Not pertinent
- 4.5 Special Hazards of Combustion
 Products: Toxic vapors given off in a fire.
- 4.6 Behavior in Fire: Not pertinent
- 4.7 Auto Ignition Temperature: 979°F
- 4.8 Electrical Hazards: Not pertinent
- 4.9 Burning Rate: 4.3 mm/min
- 4.10 Adiabatic Flame Temperature: Currently not available
- 4.11 Stoichiometric Air to Fuel Ratio: 57.1 (calc.)
- 4.12 Flame Temperature: Currently not available
- 4.13 Combustion Molar Ratio (Reactant to Product): 14.0 (calc.)
- 4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

- 5.1 Reactivity with Water: Molten naphthalene splatters and fumes in contact with water. No chemical reaction is involved.
- 5.2 Reactivity with Common Materials: None
- 5.3 Stability During Transport: Stable
- 5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
- 5.5 Polymerization: Not pertinent
- 5.6 Initiator of Polymerization: Not pertinent

6. WATER POLLUTION

- 6.1 Aquatic Toxicity: 150 mg/96 hr sunfish/TL; fresh water 1.8 ppm/72 hr rainbow trout/acute; salt water
- 6.2 Waterfowl Toxicity: Currently not available
- 6.3 Biological Oxygen Demand (BOD): (theor.) 59.5%, 6 days
- 6.4 Food Chain Concentration Potential: None
- 6.5 GESAMP Hazard Profile:
 Bioaccumulation: T
 Damage to living resources: 3
 Human Oral hazard: 2
 Human Contact Hazard: 1
 Reduction of amenity: 2

7. SHIPPING INFORMATION

- 7.1 Grades of Purity: Pure, crude; 99% Pure; mp = 178°F Crude; mp = 185-178°F
- 7.2 Storage Temperature: Elevated
- 7.3 Inert Atmosphere: No requirement
- 7.4 Venting: Open (bottle arrester) or pressure-vacuum
- 7.5 IMDG Peltion Category: 4
- 7.6 Ship Type: 2
- 7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

- 8.1 49 CFR Category: Flammable solid
- 8.2 49 CFR Class: 4.1
- 8.3 49 CFR Package Group: III
- 8.4 Marine Pollutant: Yes
- 8.5 HPPA Hazard Classification:
 Category Classification
 Health Hazard (Blue): 2
 Flammability (Red): 2
 Instability (Yellow): 0
- 8.6 EPA Reportable Quantity: 100 pounds
- 8.7 EPA Pollution Category: 3
- 8.8 RCRA Waste Number: U185
- 8.9 EPA FWPCA Line: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

- 9.1 Physical State at 15° C and 1 atm: Solid
- 9.2 Molecular Weight: 128.18
- 9.3 Boiling Point at 1 atm: 424°F = 218°C = 491°K
- 9.4 Freezing Point: 178.4°F = 80.2°C = 353.4°K
- 9.5 Critical Temperature: 887.4°F = 475.2°C = 748.4°K
- 9.6 Critical Pressure: 585 psia = 40.0 atm = 4.05 MPa
- 9.7 Specific Gravity: 1.145 at 20°C (solid)
- 9.8 Liquid Surface Tension: 31.8 dynes/cm = 0.3318 Nm at 100°C
- 9.9 Liquid Water Interfacial Tension: Currently not available
- 9.10 Vapor (Gas) Specific Gravity: Not pertinent
- 9.11 Rate of Specific Heats of Vapor (Gas): 1.069
- 9.12 Latent Heat of Vaporization: 145 Btu/lb = 80.7 cal/g = 3.38 x 10⁵ J/kg
- 9.13 Heat of Combustion: -18,720 Btu/lb = -9287 cal/g = -388.3 x 10³ J/kg
- 9.14 Heat of Decomposition: Not pertinent
- 9.15 Heat of Solution: Not pertinent
- 9.16 Heat of Polymerization: Not pertinent
- 9.17 Heat of Fusion: 35.06 cal/g
- 9.18 Limiting Value: Currently not available
- 9.19 Reid Vapor Pressure: Low

NOTES

NAPHTHALENE

NTM

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
177	69.290	180	0.342	177	0.301	180	0.437
178	69.290	200	0.391	178	0.301	185	0.784
179	69.290	220	0.441	179	0.301	190	0.735
180	69.290	240	0.410	180	0.301	195	0.690
181	69.290	260	0.419	181	0.301	200	0.648
182	69.290	280	0.420	182	0.301	205	0.608
183	69.290	300	0.438	183	0.301	210	0.573
184	69.290	320	0.447	184	0.301	215	0.540
185	69.290	340	0.457	185	0.301	220	0.509
186	69.290	360	0.466	186	0.301	225	0.480
187	69.290	380	0.475	187	0.301	230	0.454
188	69.290	400	0.485	188	0.301	235	0.429
189	69.290	420	0.494	189	0.301	240	0.406
190	69.290			190	0.301	245	0.384
191	69.290			191	0.301	250	0.364
192	69.290			192	0.301	255	0.345
193	69.290			193	0.301	260	0.327
						265	0.311
						270	0.298
						275	0.281
						280	0.267
						285	0.254
						290	0.242
						295	0.231
						300	0.221
						305	0.210

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68	0.306	180	0.148	180	0.00276	0	0.207
		200	0.254	200	0.00460	25	0.220
		220	0.438	220	0.00729	50	0.233
		240	0.670	240	0.01143	75	0.246
		260	1.032	260	0.01713	100	0.259
		280	1.544	280	0.02493	125	0.271
		300	2.256	300	0.03537	150	0.282
		320	3.200	320	0.04901	175	0.295
		340	4.433	340	0.06650	200	0.307
		360	6.075	360	0.08850	225	0.318
		380	8.138	380	0.11579	250	0.330
		400	10.720	400	0.14890	275	0.340
		420	13.910	420	0.18890	300	0.351
		440	17.810	440	0.23630	325	0.362
		460	22.490	460	0.29210	350	0.372
		480	28.090	480	0.35890	375	0.383
						400	0.393
						425	0.401
						450	0.410
						475	0.419
						500	0.428
						525	0.436
						550	0.445
						575	0.453
						600	0.460

TETRAETHYL LEAD

TEL

CAUTIONARY RESPONSE INFORMATION

Common Synonyms Lead tetraethyl TEL	Oilly liquid Colorless, but generally dyed red Sinks in water. Poisonous, flammable vapor is produced.	Colorless, but generally dyed red Fruity odor
<p>Evacuate. Keep people away. AVOID CONTACT WITH LIQUID AND VAPOR. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Call fire department. Stay upwind and use water spray to "knock down" vapor. Notify local health and pollution control agencies. Protect water intakes.</p>		
Fire	<p>Combustible. POISONOUS GASES ARE PRODUCED IN FIRE. Containers may explode in fire. Vapor may explode if ignited in an enclosed area. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Combat fires from behind barrier or protected location. Flood discharge area with water. Extinguish with water, dry chemical, foam, or carbon dioxide. Cool exposed containers with water.</p>	
Exposure	<p>CALL FOR MEDICAL AID. VAPOR POISONOUS IF INHALED OR IF SKIN IS EXPOSED. Irritating to eyes. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID POISONOUS IF SWALLOWED OR IF SKIN IS EXPOSED. Will burn eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.</p>	
Water Pollution	<p>HAZARDOUS TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>	

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Collection Systems: Pump
Do not burn

2. CHEMICAL DESIGNATIONS

- 2.1 CG Compatibility Group: Not listed.
- 2.2 Formula: $Pb(C_2H_5)_4$
- 2.3 IMO/UN Designation: 6.1/1549
- 2.4 DOT ID No.: 1649
- 2.5 CAS Registry No.: 78-00-2
- 2.6 NAERG Guide No.: 131
- 2.7 Standard Industrial Trade Classification: 51550

3. HEALTH HAZARDS

- 3.1 Personal Protective Equipment: Organic vapor type canister face mask for short periods; air line type for longer periods; neoprene-coated, liquid-proof gloves; protective goggles or face shield; white or light-colored clothing; rubber shoes or boots.
- 3.2 Symptoms Following Exposure: Increased urinary output of lead. If a large degree of absorption from inhalation or skin contact, may cause incoordination, excitability, delirium, coma and death. Do not confuse with inorganic lead.
- 3.3 Treatment of Exposure: Remove victim from contaminated area and consult physician immediately.
INGESTION: induce vomiting. SKIN: wash immediately with kerosene or similar petroleum distillate followed by soap and water.
- 3.4 TLV-TWA: 0.1 mg/m³
- 3.5 TLV-STEL: Not listed.
- 3.6 TLV-Ceiling: Not listed.
- 3.7 Toxicity by Ingestion: Oral rat LD₅₀ = 17 mg/kg
- 3.8 Toxicity by Inhalation: Currently not available.
- 3.9 Chronic Toxicity: Lead poisoning
- 3.10 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
- 3.11 Liquid or Solid Characteristics: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure.
- 3.12 Odor Threshold: Currently not available
- 3.13 IDLH Value: 40 mg Pb/m³
- 3.14 OSHA PEL-TWA: 0.075 mg/m³
- 3.15 OSHA PEL-STEL: Not listed.
- 3.16 OSHA PEL-Ceiling: Not listed.
- 3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

- 4.1 Flash Point: 185°F O.C. 200°F C.C.
- 4.2 Flammable Limits in Air: Currently not available
- 4.3 Fire Extinguishing Agents: Water, foam, dry chemical, or carbon dioxide
- 4.4 Fire Extinguishing Agents Not to Be Used: Not pertinent
- 4.5 Special Hazards of Combustion Products: Toxic gases are generated in fires.
- 4.6 Behavior in Fire: May explode in fires.
- 4.7 Auto Ignition Temperature: Decomposes above 230°F
- 4.8 Electrical Hazards: Not pertinent
- 4.9 Burning Rate: Currently not available
- 4.10 Adiabatic Flame Temperature: Currently not available
- 4.11 Stoichiometric Air to Fuel Ratio: 66.6 (calc.)
- 4.12 Flame Temperature: Currently not available
- 4.13 Combustion Molar Ratio (Reactant to Product): 19.0 (calc.)
- 4.14 Minimum Oxygen Concentration for Combustion (MOC): Not listed

5. CHEMICAL REACTIVITY

- 5.1 Reactivity with Water: No reaction
- 5.2 Reactivity with Common Materials: Rust and some metals cause decomposition.
- 5.3 Stability During Transport: Stable below 230°F. At higher temperatures, may detonate or explode when confined.
- 5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
- 5.5 Polymerization: Not pertinent
- 5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

- 6.1 Aquatic Toxicity: 0.20 mg/996 hr/bu/gill/LTL-fresh water
- 6.2 Waterflow Toxicity: Currently not available
- 6.3 Biological Oxygen Demand (BOD): Currently not available
- 6.4 Food Chain Concentration Potential: Currently not available
- 6.5 GESAMP Hazard Profile:
Bioaccumulation: +
Damage to living resources: 4
Human Oral hazard: 3
Human Contact hazard: II
Reduction of amenities: XXX

7. SHIPPING INFORMATION

- 7.1 Grades of Purity: Technical
- 7.2 Storage Temperature: Ambient
- 7.3 Inert Atmosphere: No requirement
- 7.4 Venting: Pressure-vacuum
- 7.5 IMO Pollution Category: Currently not available
- 7.6 Ship Type: Currently not available
- 7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

- 8.1 49 CFR Category: Poison
- 8.2 49 CFR Class: 6.1
- 8.3 49 CFR Package Group: I
- 8.4 Marine Pollutant: Yes
- 8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	3
Flammability (Red)	2
Instability (Yellow)	3
- 8.6 EPA Reportable Quantity: 10 pounds
- 8.7 EPA Pollution Category: A
- 8.8 RCRA Waste Number: P110
- 8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

- 9.1 Physical State at 15° C and 1 atm: Liquid
- 9.2 Molecular Weight: 323.44
- 9.3 Boiling Point at 1 atm: Decomposes
- 9.4 Freezing Point: -215°F = -137°C = 136°K
- 9.5 Critical Temperature: Not pertinent
- 9.6 Critical Pressure: Not pertinent
- 9.7 Specific Gravity: 1.633 at 20°C (liquid)
- 9.8 Liquid Surface Tension: 28.5 dynes/cm = 0.0285 Nm at (est.) 25°C
- 9.9 Liquid Water Interfacial Tension: (est.) 40 dynes/cm = 0.04 Nm at 20°C
- 9.10 Vapor (Gas) Specific Gravity: Not pertinent
- 9.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
- 9.12 Latent Heat of Vaporization: Not pertinent
- 9.13 Heat of Combustion: (est.) -7,870 Btu/lb = -4,380 cal/g = -183 X 10³ J/kg
- 9.14 Heat of Decomposition: Not pertinent
- 9.15 Heat of Solution: Not pertinent
- 9.16 Heat of Polymerization: Not pertinent
- 9.17 Heat of Fusion: Currently not available
- 9.18 Limiting Value: Currently not available
- 9.19 Reid Vapor Pressure: Currently not available

NOTES

TETRAETHYL LEAD

TEL

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
46	103.480	50	0.597		N	28	1.247
48	103.200	52	0.597		O	30	1.222
50	103.099	54	0.597		T	32	1.199
52	102.960	56	0.597		P	34	1.175
54	102.799	58	0.597		E	36	1.153
56	102.599	60	0.597		R	38	1.131
58	102.500	62	0.597		T	40	1.109
60	102.299	64	0.597		I	42	1.088
62	102.200	66	0.597		N	44	1.068
64	102.000	68	0.597		E	46	1.048
66	101.900	70	0.597		N	48	1.029
68	101.700	72	0.597		T	50	1.010
70	101.599	74	0.597			52	0.992
72	101.400	76	0.597			54	0.974
74	101.299	78	0.597			56	0.957
76	101.099	80	0.597			58	0.940
78	101.000	82	0.597			60	0.924
80	100.799	84	0.597			62	0.906
82	100.700	86	0.597			64	0.892
84	100.500	88	0.597			66	0.877
86	100.400	90	0.597			68	0.862
88	100.200	92	0.597			70	0.847
90	100.099	94	0.597			72	0.832
92	99.929	96	0.597			74	0.819
94	99.780	98	0.597			76	0.806
96	99.629	100	0.597			78	0.793

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	35	0.001	35	0.00000		N
	N	40	0.001	40	0.00001		O
	S	45	0.002	45	0.00001		T
	O	50	0.002	50	0.00001		
	L	55	0.003	55	0.00001		P
	U	60	0.003	60	0.00001		E
	B	65	0.004	65	0.00002		R
	L	70	0.005	70	0.00002		T
	E	75	0.007	75	0.00003		I
		80	0.008	80	0.00003		N
		85	0.010	85	0.00004		E
		90	0.012	90	0.00005		N
		95	0.015	95	0.00006		T
		100	0.018	100	0.00007		
		105	0.022	105	0.00009		
		110	0.027	110	0.00010		
		115	0.032	115	0.00012		
		120	0.038	120	0.00015		
		125	0.047	125	0.00017		
		130	0.056	130	0.00021		
		135	0.066	135	0.00024		
		140	0.079	140	0.00029		
		145	0.093	145	0.00034		
		150	0.110	150	0.00039		
		155	0.129	155	0.00046		

TOLUENE

TOL

CAUTIONARY RESPONSE INFORMATION

Common Synonyms	Wettable liquid	Colorless	Pleasant odor
Methylbenzene Methylbenzyl Toluol	Floats on water. Flammable, irritating vapor is produced.		
<p>Keep people away. Shut off ignition sources and call fire department. Stay upwind and use water spray to "knock down" vapor. Avoid contact with liquid and vapor. Notify local health and pollution control agencies. Protect water intakes.</p>			
Fire	<p>FLAMMABLE. Flashback during vapor test may occur. Vapor may explode if ignited in an enclosed area. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>		
Exposure	<p>CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing difficult, give oxygen. LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting or loss of consciousness. Remove contaminated clothing and shoes. Push affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>		
Water Pollution	<p>Dangerous to aquatic life in high concentrations. Floating to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>		

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Slim
Chemical and Physical Treatment: Burn
Clean shore line
Salvage material

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: 32; Aromatic Hydrocarbon
2.2 Formula: C₇H₈
2.3 UN/RUN Designation: 3.21294
2.4 DOT ID No.: 1294
2.5 CAS Registry No.: 108-88-3
2.6 NAERG Guide No.: 130
2.7 Standard Industrial Trade Classification: 51122

3. HEALTH HAZARDS

- 3.1 Personal Protective Equipment: Air-supplied mask; goggles or face shield; plastic gloves.
- 3.2 Symptoms Following Exposure: Vapors irritate eyes and upper respiratory tract, cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, grinding, diarrhea, depressed respiration.
- 3.3 Treatment of Exposure: **INHALATION:** remove to fresh air, give artificial respiration and oxygen if needed; call a doctor. **INGESTION:** do NOT induce vomiting; call a doctor. **EYES:** flush with water for at least 15 min. **SKIN:** wipe off, wash with soap and water.
- 3.4 TLV-TWA: 50 ppm
- 3.5 TLV-STEL: Not listed.
- 3.6 TLV-Ceiling: Not listed.
- 3.7 Toxicity by Ingestion: Grade 2; LD₅₀ = 0.5 to 3 g/kg
- 3.8 Toxicity by Inhalation: Currently not available.
- 3.9 Chronic Toxicity: Kidney and liver damage may follow ingestion.
- 3.10 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
- 3.11 Liquid or Solid Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
- 3.12 Odor Threshold: 0.17 ppm
- 3.13 IDLH Value: 500 ppm
- 3.14 OSHA PEL-TWA: 200 ppm
- 3.15 OSHA PEL-STEL: 500 ppm, 10 minute peak once in 8 hour shift
- 3.16 OSHA PEL-Ceiling: 300 ppm
- 3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

- 4.1 Flash Point: 55°F O.C., 40°F C.C.
- 4.2 Flammable Limits in Air: 1.27%-7.5%
- 4.3 Fire Extinguishing Agents: Carbon dioxide or dry chemical for small fires, ordinary foam for large fires.
- 4.4 Fire Extinguishing Agents Not to Be Used: Water may be ineffective.
- 4.5 Special Hazards of Combustion Products: Not pertinent.
- 4.6 Behavior in Fire: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back.
- 4.7 Auto Ignition Temperature: 598°F
- 4.8 Electrical Hazard: Class I, Group 0
- 4.9 Burning Rate: 5.7 mm/min
- 4.10 Adiabatic Flame Temperature: Currently not available
- 4.11 Stoichiometric Air to Fuel Ratio: 42.8 (calc.)
- 4.12 Flame Temperature: Currently not available
- 4.13 Combustion Molar Ratio (Reactant to Product): 11.0 (calc.)
- 4.14 Minimum Oxygen Concentration for Combustion (MOCC): N₂ diluent: 8.5%

5. CHEMICAL REACTIVITY

- 5.1 Reactivity with Water: No reaction
- 5.2 Reactivity with Common Materials: No reaction
- 5.3 Stability During Transport: Stable
- 5.4 Neutralizing Agents for Acids and Bases: Not pertinent
- 5.5 Polymerization: Not pertinent
- 5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

- 6.1 Aquatic Toxicity: 1160 mg/l 96 hr static test, freshwater
- 6.2 Waterfowl Toxicity: Currently not available
- 6.3 Biological Oxygen Demand (BOD): 0%, 5 days; 26% (theor), 5 days
- 6.4 Food Chain Concentration Potential: None
- 6.5 GESAMP Hazard Profile: Bioaccumulation: 0
Damage to living resources: 2
Human Oral hazard: 1
Human Contact hazard: 0
Reduction of amenities: XXX

7. SHIPPING INFORMATION

- 7.1 Grades of Purity: Research, reagent, nitration, at 99.8 + %; industrial contains 94 + %, with 3% styrene and small amounts of benzene and nonaromatic hydrocarbons; 90/100: less pure than industrial.
- 7.2 Storage Temperature: Ambient
- 7.3 Inert Atmosphere: No requirement
- 7.4 Venting: Open (flame arrestor) or pressure-vacuum
- 7.5 IMD Pollution Category: C
- 7.6 Ship Type: 3
- 7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

- 8.1 49 CFR Category: Flammable liquid
- 8.2 49 CFR Class: 3
- 8.3 49 CFR Package Group: II
- 8.4 Marine Pollutant: No
- 8.5 NFPA Hazard Classification:

Health Hazard (Blue)	2
Flammability (Red)	3
Instability (Yellow)	0

- 8.6 EPA Reportable Quantity: 1000 pounds
- 8.7 EPA Pollution Category: C
- 8.8 RCRA Waste Number: U220
- 8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

- 9.1 Physical State at 15°C and 1 atm: Liquid
- 9.2 Molecular Weight: 92.14
- 9.3 Boiling Point at 1 atm: 231.1°F = 110.6°C = 383.8°K
- 9.4 Freezing Point: -139°F = -95.0°C = 178.2°K
- 9.5 Critical Temperature: 605.5°F = 318.6°C = 591.8°K
- 9.6 Critical Pressure: 598.1 psia = 40.55 atm = 4.108 MPa
- 9.7 Specific Gravity: 0.867 at 20°C (liquid)
- 9.8 Liquid Surface Tension: 29.0 dyne/cm = 0.0290 N/m at 20°C
- 9.9 Liquid Water Interfacial Tension: 38.1 dyne/cm = 0.0381 N/m at 25°C
- 9.10 Vapor (Gas) Specific Gravity: Not pertinent
- 9.11 Ratio of Specific Heats of Vapor (Gas): 1.069
- 9.12 Latent Heat of Vaporization: 155 Btu/lb = 86.1 cal/g = 3.61 x 10³ J/kg
- 9.13 Heat of Combustion: -17,430 Btu/lb = -9648 cal/g = -405.5 x 10³ J/kg
- 9.14 Heat of Decomposition: Not pertinent
- 9.15 Heat of Solution: Not pertinent
- 9.16 Heat of Polymerization: Not pertinent
- 9.17 Heat of Fusion: 17.17 cal/g
- 9.18 Limiting Value: Currently not available
- 9.19 Reid Vapor Pressure: 1.1 psia

NOTES

TOLUENE

TOL

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
-10	57.188	0	0.396	0	1.028	0	1.024
-20	56.870	5	0.397	10	1.015	5	0.978
-10	56.550	10	0.399	20	1.005	10	0.925
0	56.240	15	0.400	30	0.994	15	0.894
10	55.930	20	0.402	40	0.983	20	0.857
20	55.620	25	0.403	50	0.972	25	0.821
30	55.310	30	0.404	60	0.962	30	0.784
40	54.990	35	0.406	70	0.951	35	0.757
50	54.680	40	0.407	80	0.940	40	0.727
60	54.370	45	0.409	90	0.929	45	0.700
70	54.060	50	0.410	100	0.919	50	0.673
80	53.750	55	0.411	110	0.908	55	0.649
90	53.430	60	0.413	120	0.897	60	0.625
100	53.120	65	0.414	130	0.886	65	0.602
110	52.810	70	0.415	140	0.876	70	0.582
120	52.500	75	0.417	150	0.865	75	0.562
		80	0.418	160	0.854	80	0.544
		85	0.420	170	0.843	85	0.528
		90	0.421	180	0.833	90	0.509
		95	0.422	190	0.822	95	0.493
		100	0.424	200	0.811	100	0.477
		105	0.425		0.800		
		110	0.427				
		115	0.428				
		120	0.429				
		125	0.431				

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
60	0.056	0	0.038	0	0.00070	0	0.228
		10	0.057	10	0.00103	25	0.241
		20	0.064	20	0.00150	50	0.255
		30	0.121	30	0.00512	75	0.268
		40	0.172	40	0.00396	100	0.281
		50	0.241	50	0.00485	125	0.294
		60	0.321	60	0.00547	150	0.306
		70	0.440	70	0.00727	175	0.319
		80	0.600	80	0.00954	200	0.331
		90	0.792	90	0.01237	225	0.343
		100	1.022	100	0.01584	250	0.355
		110	1.322	110	0.02007	275	0.367
		120	1.700	120	0.02516	300	0.378
		130	2.148	130	0.03127	325	0.389
		140	2.690	140	0.03850	350	0.400
		150	3.328	150	0.04700	375	0.411
		160	4.109	160	0.05691	400	0.422
		170	5.018	170	0.06840	425	0.432
		180	6.062	180	0.08142	450	0.443
		190	7.323	190	0.09673	475	0.453
		200	8.758	200	0.11400	500	0.462
		210	10.410	210	0.13340	525	0.472
						550	0.482
						575	0.491
						600	0.500

M-XYLENE

XLm

CAUTIONARY RESPONSE INFORMATION

Common Synonyms 1,3-Dimethylbenzene Xylol		Watery liquid	Colorless	Sweet odor
		Floats on water. Flammable, irritating vapor is produced.		
Keep people away. Shut off ignition sources and call fire department. Avoid contact with liquid and vapor. Notify local health and pollution control agencies. Protect water intakes.				
Fire	FLAMMABLE Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Extinguish with foam, dry chemical, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.			
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose, and throat. If inhaled, will cause headache, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting, or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. If in EYES, hold eyelids open and flush with plenty of water. If SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.			
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. Floating to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.			

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Skim
Chemical and Physical Treatment: Burn
Clean shore line
Salvage waterfowl

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: 12; Aromatic Hydrocarbon
2.2 Formula: m-C₆H₄(CH₃)₂
2.3 IMDUN Designation: 3.2/1307
2.4 DOT ID No.: 1507
2.5 CAS Registry No.: 108-38-3
2.6 NAERG Guide No.: 150
2.7 Standard Industrial Trade Classification: 51124

3. HEALTH HAZARDS

- 3.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
- 3.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma; can be fatal. Kidney and liver damage can occur.
- 3.3 Treatment of Exposure: **INHALATION:** remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. **INGESTION:** do NOT induce vomiting; call a doctor. **EYES:** flush with water for at least 15 min. **SKIN:** wipe off, wash with soap and water.
- 3.4 TLV-TWA: 100 ppm
- 3.5 TLV-STEL: 150 ppm
- 3.6 TLV-Ceiling: Not listed.
- 3.7 Toxicity by Ingestion: Green 3; LD₅₀ = 50 to 500 g/kg
- 3.8 Toxicity by Inhalation: Currently not available.
- 3.9 Chronic Toxicity: Kidney and liver damage.
- 3.10 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if pressure in high concentrations. The effect is temporary.
- 3.11 Liquid or Solid Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause stinging and reddening of the skin.
- 3.12 Odor Threshold: 0.05 ppm
- 3.13 IDLH Value: 500 ppm
- 3.14 OSHA PEL-TWA: 100 ppm
- 3.15 OSHA PEL-STEL: Not listed
- 3.16 OSHA PEL-Ceiling: Not listed
- 3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

- 4.1 Flash Point: 81°F C.C.
- 4.2 Flammable Limits in Air: 1.1%-7.0%
- 4.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide
- 4.4 Fire Extinguishing Agents Not to Be Used: Water may be ineffective.
- 4.5 Special Hazards of Combustion Products: Not pertinent
- 4.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
- 4.7 Auto Ignition Temperature: 927°F
- 4.8 Electrical Hazards: Class I, Group D
- 4.9 Burning Rate: 5.8 mm/min
- 4.10 Adiabatic Flame Temperature: Currently not available
- 4.11 Stoichiometric Air to Fuel Ratio: 50.0 (calc.)
- 4.12 Flame Temperature: Currently not available
- 4.13 Combustion Molar Ratio (Reactant to Product): 13.0 (calc.)
- 4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

- 5.1 Reactivity with Water: No reaction
- 5.2 Reactivity with Common Materials: No reaction
- 5.3 Stability During Transport: Stable
- 5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
- 5.5 Polymerization: Not pertinent
- 5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

- 6.1 Aquatic Toxicity: 22 ppm/96 hr/fatality/TL₅₀ fresh water
- 6.2 Waterfowl Toxicity: Currently not available
- 6.3 Biological Oxygen Demand (BOD): 0 g/lb, 5 days; 0% (prior.), 8 days
- 6.4 Food Chain Concentration Potential: Currently not available
- 6.5 GESAMP Hazard Profile: Bioaccumulation: 0
Damage to living resources: 3
Human Oral hazard: 1
Human Contact hazard: II
Reduction of amenities: XX

7. SHIPPING INFORMATION

- 7.1 Grades of Purity: Research: 99.99%; Pure: 99.9%; Technical: 99.2%
- 7.2 Storage Temperature: Ambient
- 7.3 Inert Atmosphere: No requirement
- 7.4 Venting: Open (flame arrester) or pressure-vacuum
- 7.5 IMO Pollution Category: C
- 7.6 Ship Type: 3
- 7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

- 8.1 49 CFR Category: Flammable liquid
- 8.2 49 CFR Class: 3
- 8.3 49 CFR Package Group: III
- 8.4 Marine Pollutant: No
- 8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Instability (Yellow)	0
- 8.6 EPA Reportable Quantity: 1000 pounds
- 8.7 EPA Pollution Category: C
- 8.8 RCRA Waste Number: U235
- 8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

- 9.1 Physical State at 15°C and 1 atm: Liquid
- 9.2 Molecular Weight: 106.16
- 9.3 Boiling Point at 1 atm: 282°F = 139.5°C = 412.1°K
- 9.4 Freezing Point: -54.2°F = -47.9°C = 223.3°K
- 9.5 Critical Temperature: 850.8°F = 343.8°C = 817°K
- 9.6 Critical Pressure: 513.8 atm = 34.95 psia = 3.540 MPa
- 9.7 Specific Gravity: 0.864 at 20°C (liquid)
- 9.8 Liquid Surface Tension: 28.5 dynes/cm = 0.0288 N/m at 20°C
- 9.9 Liquid Water Interfacial Tension: 36.4 dynes/cm = 0.0364 N/m at 30°C
- 9.10 Vapor (Gas) Specific Gravity: Not pertinent
- 9.11 Ratio of Specific Heats of Vapor (Gas): 1.071
- 9.12 Latent Heat of Vaporization: 147 Btu/lb = 81.9 cal/g = 3.42 x 10⁵ J/kg
- 9.13 Heat of Combustion: -17,554 Btu/lb = -9752.4 cal/g = -408.31 x 10³ J/kg
- 9.14 Heat of Decomposition: Not pertinent
- 9.15 Heat of Solution: Not pertinent
- 9.16 Heat of Polymerization: Not pertinent
- 9.17 Heat of Fusion: 26.01 cal/g
- 9.18 Limiting Value: Currently not available
- 9.19 Reid Vapor Pressure: 0.34 psia

NOTES

M-XYLENE

XLM

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
15	55.400	40	0.387	35	0.362	15	0.938
20	55.264	50	0.393	40	0.364	20	0.898
25	55.120	60	0.398	45	0.364	25	0.862
30	54.990	70	0.404	50	0.363	30	0.827
35	54.850	80	0.410	55	0.358	35	0.794
40	54.710	90	0.415	60	0.357	40	0.764
45	54.570	100	0.421	65	0.358	45	0.735
50	54.430	110	0.426	70	0.359	50	0.706
55	54.290	120	0.432	75	0.359	55	0.682
60	54.160	130	0.437	80	0.361	60	0.658
65	54.020	140	0.443	85	0.373	65	0.635
70	53.890	150	0.446	90	0.364	70	0.613
75	53.740	160	0.454	95	0.355	75	0.592
80	53.600	170	0.460	100	0.346	80	0.571
85	53.460	180	0.465			85	0.554
90	53.320	190	0.471				
95	53.180	200	0.476				
100	53.050	210	0.482				

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	60	0.096	60	0.00172	0	0.247
	M	70	0.127	70	0.00238	25	0.260
	S	80	0.177	80	0.00324	50	0.272
	O	90	0.242	90	0.00435	75	0.286
	L	100	0.328	100	0.00577	100	0.299
	U	110	0.434	110	0.00754	125	0.311
	S	120	0.571	120	0.00973	150	0.324
	L	130	0.743	130	0.01147	175	0.338
	E	140	0.956	140	0.01377	200	0.348
		150	1.219	150	0.01677	225	0.360
		160	1.538	160	0.020435	250	0.371
		170	1.924	170	0.025023	275	0.382
		180	2.380	180	0.030891	300	0.394
		190	2.935	190	0.044773	325	0.406
		200	3.590	200	0.05382	350	0.417
		210	4.353	210	0.06431	375	0.427
		220	5.247	220	0.078035	400	0.438
		230	6.282	230	0.096009	425	0.449
		240	7.476	240	0.10570	450	0.459
		250	8.846	250	0.12330	475	0.469
		260	10.410	260	0.14310	500	0.479
						525	0.489
						550	0.499
						575	0.508
						600	0.517

O-XYLENE

XLO

CAUTIONARY RESPONSE INFORMATION

Common Synonyms 1,2-Dimethylbenzene Xylol		Watery liquid	Colorless	Sweet odor
		Floats on water. Flammable, irritating vapor is produced.		
Keep people away. Shut off ignition sources and call fire department. Avoid contact with liquid and vapor. Notify local health and pollution control agencies. Protect water intakes.				
Fire	FLAMMABLE Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Extinguish with foam, dry chemical, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.			
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause headache, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting, or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. If IN EYES, hold eyelids open and flush with plenty of water. If SWALLOWED and victim is CONSCIOUS , have victim drink water or milk. DO NOT INDUCE VOMITING.			
Water Pollution	Dangerous to aquatic life in high concentrations. Floating to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.			

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Slam
Chemical and Physical Treatment: Burn
Clean shore line
Salvage waterfront

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: 32, Aromatic Hydrocarbon
2.2 Formula: C_8H_{10}
2.3 IAC/UN Designation: 3.2/1307
2.4 DOT ID No.: 1307
2.5 CAS Registry No.: 95-47-8
2.6 NAERG Guide No.: 130
2.7 Standard Industrial Trade Classification: S1124

3. HEALTH HAZARDS

3.1 Personal Protective Equipment: Approved canister or air-supplied mask goggles or face shield, plastic gloves and boots.
3.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If inhaled, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur.
3.3 Treatment of Exposure: **INHALATION:** remove to fresh air, administer artificial respiration and oxygen if required; call a doctor. **INGESTION:** do NOT induce vomiting; call a doctor. **EYES:** flush with water for at least 15 min. **SKIN:** wipe off, wash with soap and water.
3.4 TLV-TWA: 100 ppm
3.5 TLV-STEL: 150 ppm
3.6 TLV-CEILING: Not listed
3.7 Toxicity by Ingestion: Grade 3; LD₅₀ = 50 to 500 mg/kg
3.8 Toxicity by Inhalation: Currently not available.
3.9 Chronic Toxicity: Kidney and liver damage.
3.10 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if present in high concentrations. The effect is temporary.
3.11 Liquid or Solid Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, they cause smearing and staining of the skin.
3.12 Odor Threshold: 0.05 ppm
3.13 IDLH Value: 900 ppm
3.14 OSHA PEL-TWA: 100 ppm
3.15 OSHA PEL-STEL: Not listed
3.16 OSHA PEL-CEILING: Not listed
3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

4.1 Flash Point: 90°F C.C.
4.2 Flammable Limits in Air: 0.3 - 6.7%
4.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide
4.4 Fire Extinguishing Agents Not to Be Used: Water may be ineffective.
4.5 Special Hazards of Combustion Products: Not pertinent
4.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
4.7 Auto Ignition Temperature: 589°F
4.8 Electrical Hazard: Class I, Group D
4.9 Burning Rate: 5.8 mm/min
4.10 Adiabatic Flame Temperature: Currently not available
4.11 Stoichiometric Air to Fuel Ratio: 50.0 (calc.)
4.12 Flame Temperature: Currently not available
4.13 Combustion Molar Ratio (Reactant to Product): 13.0 (calc.)
4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

5.1 Reactivity with Water: No reaction
5.2 Reactivity with Common Materials: No reaction
5.3 Stability During Transport: Stable
5.4 Neutralizing Agents for Acids and Bases: Not pertinent
5.5 Polymerization: Not pertinent
5.6 Initiator of Polymerization: Not pertinent

6. WATER POLLUTION

6.1 Aquatic Toxicity: >100 mg/l/96 hr/D, mg/L/LT/fresh water
6.2 Watertown Toxicity: Currently not available
6.3 Biological Oxygen Demand (BOD): 0 lbs/l, 3 days; 2.5% (theor.), 8 days
6.4 Food Chain Concentration Potential: Currently not available
6.5 GESAMP Hazard Profile: Bioaccumulation: 0
Damage to living resources: 3
Human Oral hazard: 1
Human Contact hazard: 1
Reduction of amenities: X

7. SHIPPING INFORMATION

7.1 Grades of Purity, Assay: 99.99%, Pure; 99.7%, Commercial; 95-98%
7.2 Storage Temperature: Ambient
7.3 Inert Atmosphere: No reaction
7.4 Venting: Open (flame arrestor) or pressure-vacuum
7.5 IMD Pollution Category: C
7.6 Ship Type: 3
7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

8.1 49 CFR Category: Flammable liquid
8.2 49 CFR Class: 3
8.3 49 CFR Package Group: II
8.4 Marine Pollutant: No
8.5 NFPA Hazard Classification:
Category _____ Classification _____
Health Hazard (Blue) _____ 2
Flammability (Red) _____ 3
Instability (Yellow) _____ 0
8.6 EPA Reportable Quantity: 1000 pounds
8.7 EPA Pollution Category: C
8.8 RCRA Waste Number: U238
8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 Physical State at 15° C and 1 atm: Liquid
9.2 Molecular Weight: 106.16
9.3 Boiling Point at 1 atm: 291.5°F = 144.4°C = 417.6°K
9.4 Freezing Point: -13.3°F = -25.2°C = 248.0°K
9.5 Critical Temperature: 874.9°F = 357.1°C = 830.1°K
9.6 Critical Pressure: 541.5 atm = 36.84 psia = 3.732 MPa
9.7 Specific Gravity: 0.860 at 20°C (liquid)
9.8 Liquid Surface Tension: 30.53 dynes/cm = 0.03053 N/m at 15.5°C
9.9 Liquid Water Interfacial Tension: 36.08 dynes/cm = 0.03608 N/m at 20°C
9.10 Vapor (Gas) Specific Gravity: Not pertinent
9.11 Ratio of Specific Heats of Vapor (Gas): 1.088
9.12 Latent Heat of Vaporization: 149 Btu/lb = 82.9 cal/g = 3.47 X 10⁵ J/kg
9.13 Heat of Combustion: -17,538 Btu/lb = -8754.7 cal/g = -408.41 X 10³ J/kg
9.14 Heat of Decomposition: Not pertinent
9.15 Heat of Solution: Not pertinent
9.16 Heat of Polymerization: Not pertinent
9.17 Heat of Fusion: 30.84 cal/g
9.18 Limiting Value: Currently not available
9.19 Reid Vapor Pressure: 0.28 psia

NOTES

O-XYLENE

XLO

9.10 SATURATED LIQUID DENSITY		9.11 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
15	54.460	35	0.389	35	1.943	15	1.328
20	54.330	40	0.391	40	1.835	20	1.283
25	54.190	45	0.394	45	1.627	25	1.202
30	54.050	50	0.396	50	1.618	30	1.145
35	53.910	55	0.398	55	1.610	35	1.092
40	53.770	60	0.400	60	1.602	40	1.042
45	53.630	65	0.402	65	0.993	45	0.995
50	53.490	70	0.404	70	0.977	50	0.952
55	53.350	75	0.406	75	0.965	55	0.911
60	53.220	80	0.408	80	0.960	60	0.872
65	53.080	85	0.411	85	0.950	65	0.836
70	52.940	90	0.413	90	0.932	70	0.802
75	52.800	95	0.415	95	0.944	75	0.770
80	52.660	100	0.417	100	0.935	80	0.746
85	52.520					85	0.712
90	52.380						
95	52.250						
100	52.110						

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	60	0.071	60	0.09135	0	0.281
	N	70	0.101	70	0.09180	15	0.274
	S	80	0.141	80	0.09250	30	0.267
	O	90	0.194	90	0.09349	45	0.259
	L	100	0.262	100	0.09464	60	0.251
	U	110	0.352	110	0.09611	75	0.242
	B	120	0.462	120	0.09794	90	0.235
	L	130	0.609	130	0.01021	105	0.247
	E	140	0.787	140	0.01298	120	0.258
		150	1.005	150	0.01624	135	0.270
		160	1.277	160	0.02038	150	0.281
		170	1.605	170	0.02520	165	0.292
		180	1.999	180	0.03098	180	0.303
		190	2.465	190	0.03759	200	0.314
		200	3.028	200	0.04529	225	0.324
		210	3.688	210	0.05443	250	0.335
		220	4.456	220	0.06464	275	0.346
		230	5.352	230	0.07674	300	0.357
		240	6.389	240	0.09008	325	0.368
		250	7.581	250	0.10568	350	0.379
		260	8.947	260	0.12390	375	0.390
						400	0.401
						425	0.412
						450	0.423
						475	0.434
						500	0.445
						525	0.456
						550	0.467
						575	0.478
						600	0.489

P-XYLENE

XLP

CAUTIONARY RESPONSE INFORMATION

Common Synonyms 1,4-Dimethylbenzene Xylen	Watery liquid	Colorless	Sweet odor
Flots on water. Flammable, irritating vapor is produced. Freezing point is 58°F			
Keep people away Shut off ignition sources and call fire department. Avoid contact with liquid and vapor. Notify local health and pollution control agencies. Protect water intakes.			
Fire	FLAMMABLE Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Extinguish with foam, dry chemical, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water		
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause dizziness, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting, loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.		
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		

1. CORRECTIVE RESPONSE ACTIONS

Stop discharge
Contain
Collection Systems: Skin
Chemical and Physical Treatment: Burn
Clean shore line
Salvage waterfowl

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: 12; Aromatic Hydrocarbon
2.2 Formula: $C_6H_4(CH_3)_2$
2.3 IMQUN Designation: 3.21307
2.4 DOT ID No.: 1307
2.5 CAS Registry No.: 106-42-3
2.6 HAZERG Guide No.: 130
2.7 Standard Industrial Trade Classification: 51124

3. HEALTH HAZARDS

3.1 Personal Protective Equipment: Approved canister or air-supplied mask, goggles or face shield, plastic gloves and boots.
3.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur.
3.3 Treatment of Exposure: **INHALATION:** remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. **INGESTION:** do NOT induce vomiting; call a doctor. **EYES:** Flush with water for at least 15 min. **SKIN:** wipe off; wash with soap and water.
3.4 TLV-TWA: 100 ppm
3.5 TLV-STEL: 150 ppm
3.6 TLV-Ceiling: Not listed
3.7 Toxicity by Ingestion: Grade 3; LD₅₀ = 50 to 500 mg/kg
3.8 Toxicity by Inhalation: Currently not available.
3.9 Chronic Toxicity: Kidney and liver damage.
3.10 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if present in high concentrations. The effect is temporary.
3.11 Liquid or Solid Characteristics: Minimum hazard. If soaked on clothing and allowed to remain, may cause stinging and reddening of the skin.
3.12 Odor Threshold: 0.05 ppm
3.13 IDLH Value: 900 ppm
3.14 OSHA PEL-TWA: 100 ppm
3.15 OSHA PEL-STEL: Not listed
3.16 OSHA PEL-Ceiling: Not listed
3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

4.1 Flash Point: 51°F C.C.
4.2 Flammable Limits in Air: 1.1%-7.0%
4.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide
4.4 Fire Extinguishing Agents Not to Be Used: Water may be ineffective.
4.5 Special Hazards of Combustion Products: Not pertinent
4.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
4.7 Auto Ignition Temperature: 584°F
4.8 Electrical Hazard: Class I, Group 0
4.9 Burning Rate: 5.8 cm/min
4.10 Adiabatic Flame Temperature: Currently not available
4.11 Stoichiometric Air to Fuel Ratio: 50.0 (calc.)
4.12 Flame Temperature: Currently not available
4.13 Combustion Molar Ratio (Reactant to Product): 13.0 (calc.)
4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

5.1 Reactivity with Water: No reaction
5.2 Reactivity with Common Materials: No reaction
5.3 Stability During Transport: Stable
5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
5.5 Polymerization: Not pertinent
5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

6.1 Aquatic Toxicity: 22 ppm/96 hr/freshwater
6.2 Waterfowl Toxicity: Currently not available
6.3 Biological Oxygen Demand (BOD): 0 lb/lb in 3 days
6.4 Food Chain Concentration Potential: Currently not available
6.5 GESAMP Hazard Profile: Bioaccumulation: 0
Damage to living resources: 3
Human Oral hazard: 1
Reduction of sensitivity: X

7. SHIPPING INFORMATION

7.1 Grades of Purity: Research: 99.99%, Pure: 99.99%, Technical: 99.0%
7.2 Storage Temperature: Ambient
7.3 Inert Atmosphere: No requirement
7.4 Venting: Open (flame arrester) or pressure-vacuum
7.5 IMD Pollution Category: C
7.6 Ship Type: J
7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

8.1 49 CFR Category: Flammable liquid
8.2 49 CFR Class: 3
8.3 49 CFR Package Group: III
8.4 Marine Pollutant: No
8.5 NPPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Instability (Yellow)	0

8.6 EPA Reportable Quantity: 100 pounds
8.7 EPA Pollution Category: 5
8.8 RCRA Waste Number: U239
8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 Physical State at 15°C and 1 atm: Liquid
9.2 Molecular Weight: 106.16
9.3 Boiling Point at 1 atm: 280.9°F = 138.3°C = 411.5°K
9.4 Freezing Point: 55.9°F = 13.3°C = 286.5°K
9.5 Critical Temperature: 549.4°F = 343.0°C = 816.2°K
9.6 Critical Pressure: 509.4 atm = 34.85 psia = 3.510 MPa
9.7 Specific Gravity: 0.861 at 20°C (liquid)
9.8 Liquid Surface Tension: 25.3 dynes/cm = 0.0253 N/m at 20°C
9.9 Liquid Water Interfacial Tension: 27.8 dynes/cm = 0.0278 N/m at 20°C
9.10 Vapor (Gas) Specific Gravity: Not pertinent
9.11 Ratio of Specific Heats of Vapor (Gas): 1.071
9.12 Latent Heat of Vaporization: 150 Btu/lb = 81 cal/g = 3.4×10^5 J/kg
9.13 Heat of Combustion: -17,558 Btu/lb = -9754.7 cal/g = -408.41×10^3 J/kg
9.14 Heat of Decomposition: Not pertinent
9.15 Heat of Solution: Not pertinent
9.16 Heat of Polymerization: Not pertinent
9.17 Heat of Fusion: 37.53 cal/g
9.18 Limiting Value: Currently not available
9.19 Reid Vapor Pressure: 0.34 psia

NOTES

P-XYLENE

XLP

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hoursquare foot-F	Temperature (degrees F)	Centipoise
60	53.970	60	0.412	60	0.333	60	0.878
65	53.938	70	0.418	65	0.323	65	0.854
70	53.898	80	0.424	70	0.321	70	0.831
75	53.858	90	0.429	75	0.314	75	0.810
80	53.818	100	0.435	80	0.307	80	0.790
85	53.778	110	0.440	85	0.300	85	0.771
90	53.740	120	0.444	90	0.292	90	0.752
95	53.698	130	0.451	95	0.285	95	0.733
100	53.660	140	0.457	100	0.278	100	0.719
105	53.720	150	0.462			105	0.703
110	53.588	160	0.466			110	0.688
115	53.446	170	0.474			115	0.674
120	53.308	180	0.479			120	0.660
		190	0.485				
		200	0.490				
		210	0.496				
		220	0.501				
		230	0.507				
		240	0.512				
		250	0.518				
		260	0.524				
		270	0.529				
		280	0.535				

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	60	0.096	60	0.00163	0	0.248
	N	70	0.133	70	0.00232	25	0.258
	S	80	0.187	80	0.00343	50	0.272
	O	90	0.255	90	0.00498	75	0.285
	L	100	0.343	100	0.00697	100	0.297
	U	110	0.458	110	0.00932	125	0.309
	B	120	0.599	120	0.01222	150	0.321
	L	130	0.777	130	0.01603	175	0.333
	E	140	0.996	140	0.02046	200	0.345
		150	1.279	150	0.02559	225	0.357
		160	1.608	160	0.03133	250	0.368
		180	1.956	170	0.03734	275	0.380
		190	2.041	180	0.04382	300	0.391
		200	2.719	190	0.04629	325	0.402
		210	4.493	210	0.05561	350	0.413
		220	5.407	220	0.06638	375	0.424
		230	6.465	230	0.07867	400	0.435
		240	7.582	240	0.09270	425	0.445
		250	9.080	250	0.10860	450	0.456
		260	10.670	260	0.12650	475	0.466
					0.14670	500	0.476
						525	0.486
						550	0.496
						575	0.505
						600	0.515



ATTACHMENT B

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT

Health and Safety Plan Acknowledgement

I have reviewed the Health and Safety Plan (HASP) for the Investigation Plan project in Hartford Illinois. I agree to abide by the safety requirements described in the HASP.

_____	_____	_____
printed name	signature	date
_____	_____	_____
printed name	signature	date
_____	_____	_____
printed name	signature	date
_____	_____	_____
printed name	signature	date
_____	_____	_____
printed name	signature	date
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printed name	signature	date
_____	_____	_____
printed name	signature	date
_____	_____	_____
printed name	signature	date

ATTACHMENT C

ACCIDENT/INJURY REPORT FORM

CLAYTON GROUP SERVICES
ACCIDENT / INJURY REPORT



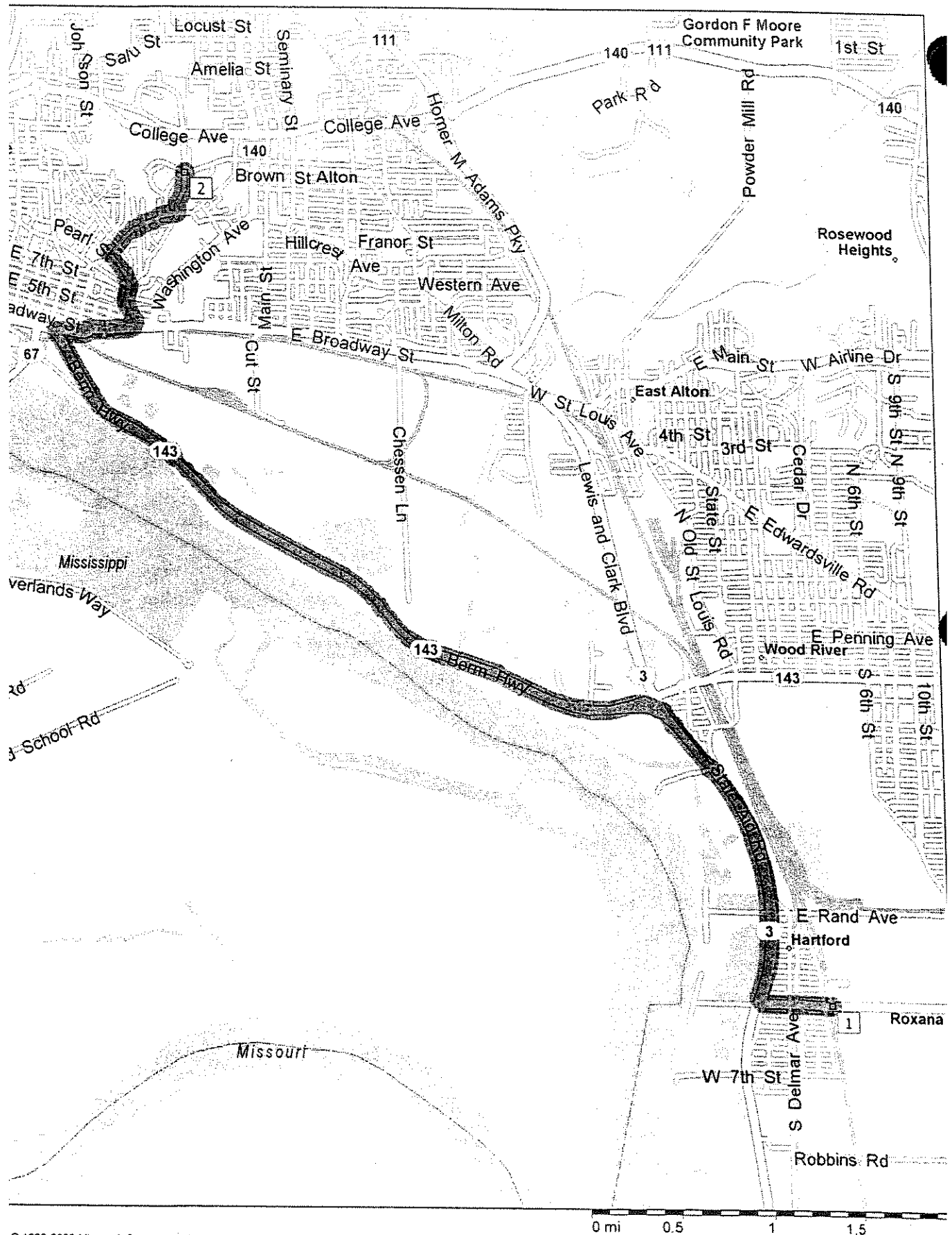
1. INJURED:		2. SSN: _____		4. SEX: _____ <input type="checkbox"/> M <input type="checkbox"/> F		5. DATE of ACCIDENT: _____	
3. DOB: _____		7. JOB TITLE: _____		8. DUTIES AT TIME OF ACCIDENT: _____			
9. SUPERVISOR: _____		10. LENGTH of EMPLOYMENT: <input type="checkbox"/> < 1 mo. <input type="checkbox"/> 6 mos. to 5 yrs. <input type="checkbox"/> 1 - 5 mos. <input type="checkbox"/> > 5 yrs.		11. EXPERIENCE W/ DUTIES: <input type="checkbox"/> < 1 mo. <input type="checkbox"/> 6 mos. to 5 yrs. <input type="checkbox"/> 1 - 5 mos. <input type="checkbox"/> > 5 yrs.			
12. RE of INJURY: _____							
13. PART of BODY INJURED: _____		14. NAMES / AFFILIATIONS of OTHERS INJURED: _____					
15. NAME and ADDRESS of PHYSICIAN: _____				16. TIME of INJURY: _____ <input type="checkbox"/> AM <input type="checkbox"/> PM		17. SEVERITY of INJURY: <input type="checkbox"/> Fatality <input type="checkbox"/> Lost Workdays - days away from work <input type="checkbox"/> Lost Workdays - days of restricted duty <input type="checkbox"/> Medical Treatment <input type="checkbox"/> First Aid <input type="checkbox"/> Other, specify _____	
18. NAME and ADDRESS of HOSPITAL: _____				20. PHASE of WORKDAY at TIME of INJURY: <input type="checkbox"/> During rest period <input type="checkbox"/> Arriving/Leaving Work <input type="checkbox"/> During meal period <input type="checkbox"/> Performing Job Duties <input type="checkbox"/> Working overtime <input type="checkbox"/> Other _____			
19. SPECIFIC LOCATION of ACCIDENT: _____				20. PHASE of WORKDAY at TIME of INJURY: <input type="checkbox"/> During rest period <input type="checkbox"/> Arriving/Leaving Work <input type="checkbox"/> During meal period <input type="checkbox"/> Performing Job Duties <input type="checkbox"/> Working overtime <input type="checkbox"/> Other _____			
21. DESCRIBE HOW the ACCIDENT OCCURRED: _____ _____ _____ _____ _____							
22. ACCIDENT SEQUENCE: Describe in reverse order of occurrence of events preceding the injury or accident. Starting with the injury and moving backward in time, reconstruct the sequence of events that led to the injury. Primary Event: _____ _____ _____ _____ _____ Identifying Event: _____ _____ _____ _____ _____ Preceding above event: _____ _____ _____ _____ _____ Preceding above event: _____ _____ _____ _____ _____							

ATTACHMENT D

DIRECTIONS/MAP – ROUTE TO HOSPITAL

201 E Hawthorne St, Hartford, IL 62048 to 1 Memorial Dr, Alton, IL 62002

7.9 miles; 15 minutes



- VI 0.0 mi **1** Depart 201 E Hawthorne St, Hartford, IL 62048 on (E) Hawthorne St (West) for 0.4 mi
- VI 0.4 mi Bear RIGHT (North-West) onto Local road(s) for 76 yds
- VI 0.4 mi Bear RIGHT (North) onto SR-3 for 1.8 mi
- VI 2.2 mi Bear LEFT (West) onto Local road(s) for 0.2 mi
- VI 2.4 mi Bear LEFT (West) onto SR-143 [Berm Hwy] for 4.0 mi
- VI 6.3 mi Turn RIGHT (East) onto Broadway Con for 0.2 mi
- VI 6.6 mi Turn RIGHT (East) onto E Broadway St for 0.2 mi
- VI 6.8 mi Turn LEFT (North) onto Pearl St for 0.5 mi
- VI 7.3 mi Turn RIGHT (North-East) onto Brown St for 0.5 mi
- VI 7.7 mi Turn LEFT (North) onto Rock Springs Dr for 0.2 mi
- VI 7.9 mi **2** Arrive 1 Memorial Dr, Alton, IL 62002

Route Summary

ourney cost	\$0.50
g distance	7.9 miles
uration	15 minutes
g time	15 minutes
s flight distance between all stops	6.0 miles

Route Segment Details

	To	Method	Distance	Driving Time
Hawthorne St,...	1 Memorial Dr, Alton,...	Quickest	7.9 miles	15 minutes

Distance by State/Province

Province	Distance	Driving Time
	7.9 miles	15 minutes